Compressed Air Magazine

SEPTEMBER 1961

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- MAINTAINING JETS
- BUILDING HOTELS
- CONVERTING WATER

COMPRESSED AIR MAGAZINE
PHILLIPSBURG, N. J.

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Bethlehem Wire Rope serves world's most powerful radio station

On a remote Maine peninsula a huge antenna web forms the heart of the world's most powerful radio station. It is hung from 26 steel towers which range in height from 700 to 1000 ft. Bethlehem furnished 124,000 ft of $2\frac{3}{4}$-in. diameter prestretched, bethanized (electrolytically zinc-coated) wire rope for a balancing system of 36 counterweights, each weighing 200 tons. The rope raises, lowers, and holds the antenna taut despite fluctuations in temperature, ice loads, and high winds.

A key communications center for the U. S. Navy, this very low frequency transmitter can make instantaneous contact with both surface and undersea craft thousands of miles away.

Bethlehem Wire Rope has great strength and durability. And when the individual wires are bethanized—coated electrolytically with a uniform, tightly bonded jacket of 99.9% pure zinc—the rope offers effective protection from atmospheric corrosion. Its excellent fatigue-resisting properties are important on installations of this type, where vibration is a constant problem.

If you would like full information about Bethlehem Wire Rope, simply get in touch with the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

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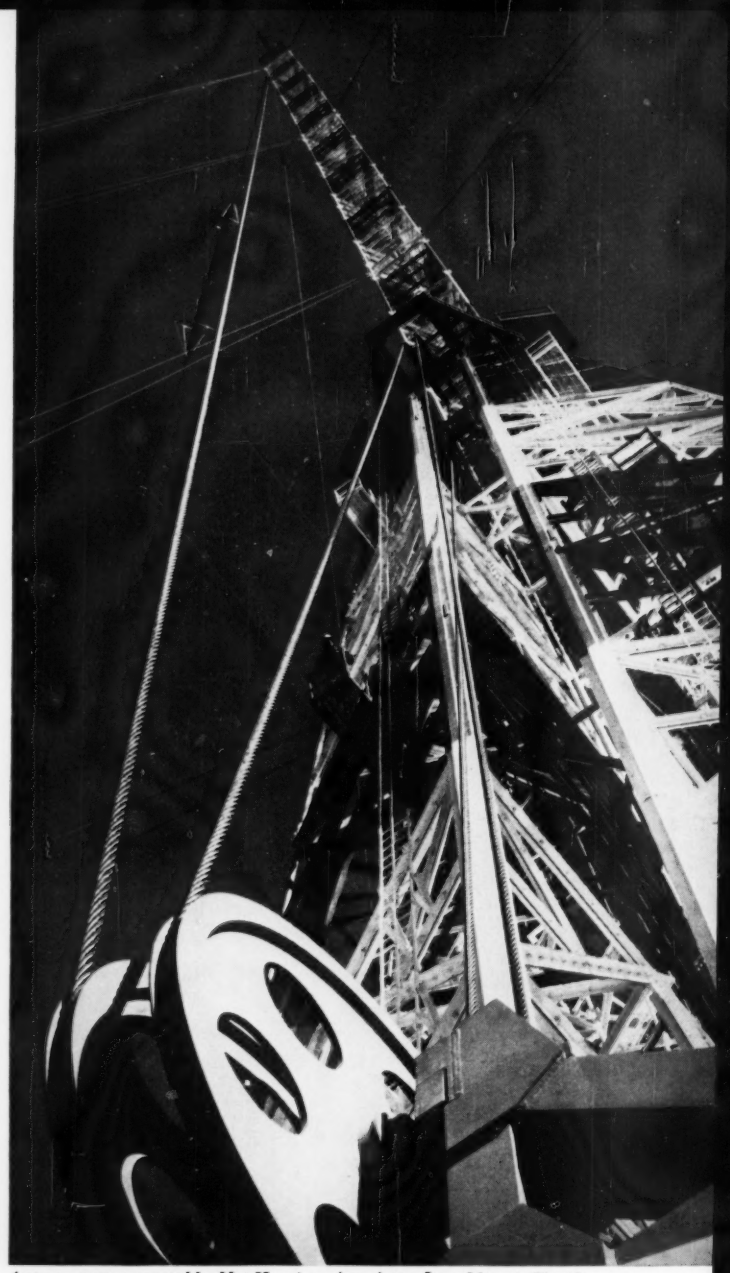
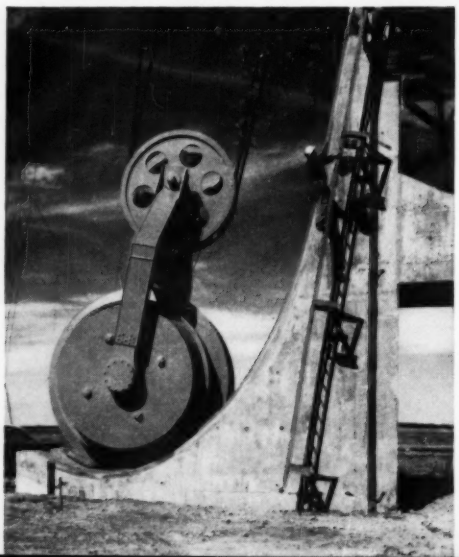
There's a distributor of Bethlehem Rope near you, supplied by our nationwide network of wire rope mill depots.



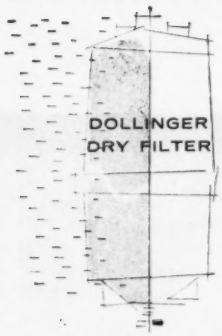
Antenna system erected by Nat Harrison Associates, Inc., Miami, Florida.



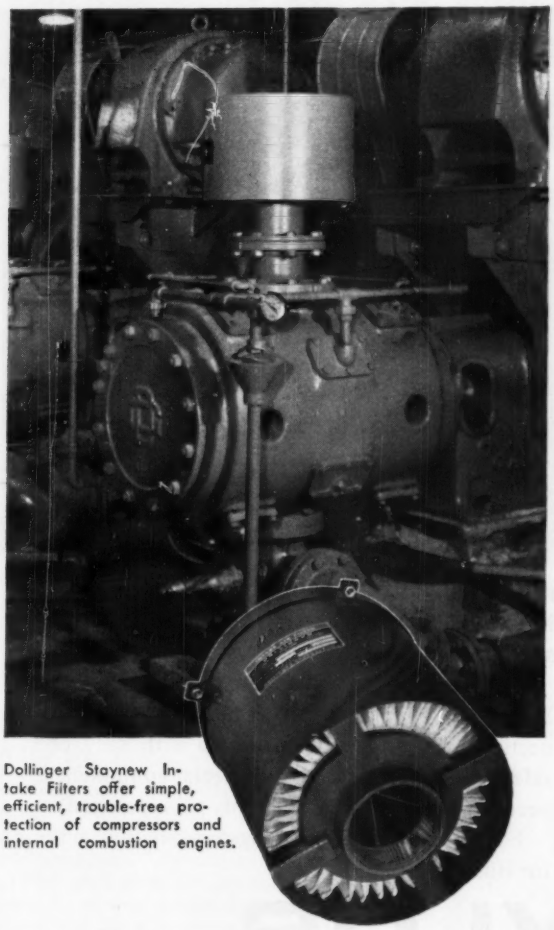
Steel

for strength
. . . economy
. . . versatility

This counterweight, one of 36 supplied by Bethlehem, weighs a whopping 400,000 pounds. Bethlehem Rope has the muscle to handle loads like this with ease.



IMPROVE COMPRESSOR PERFORMANCE BY SIMPLE, EFFICIENT REMOVAL OF DUST



Dollinger Staynew Intake Filters offer simple, efficient, trouble-free protection of compressors and internal combustion engines.

Dollinger Staynew Intake Filters are designed for direct application to engines, compressors and blowers, or to outdoor piping without the need for foundations, supporting frames, or weather louvers.

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Available from 60 to 20,000 C.F.M. capacities in single units . . . multiple units available for larger capacities. Consult your local Dollinger representative for more details. Or, write for Bulletin 100. Dollinger Corporation, 7 Centre Park, Rochester 3, New York.

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How NAYLOR "Twin-Performance" Pays Off in Savings

NAYLOR Wedgelock couplings make a positive connection, securely anchored in standard weight grooved ends.

Over the years, NAYLOR Spiralweld pipe and Wedgelock couplings have proved a cost-cutting combination for pipe lines in air, water, dredging and ventilating service.

The light weight of NAYLOR pipe adds up to important economies. Lower transportation costs. Easier handling. Faster installation. But there is no sacrifice of strength because the exclusive NAYLOR Spiralweld structure provides the extra strength and safety your jobs require.

Further savings are assured through the Wedgelock coupling. You get fastest possible connections. Lines can be made up with only one side of the pipe exposed. No special equipment is necessary—a hammer is the only tool required.

For details on this working combination, write for Bulletin No. 59.

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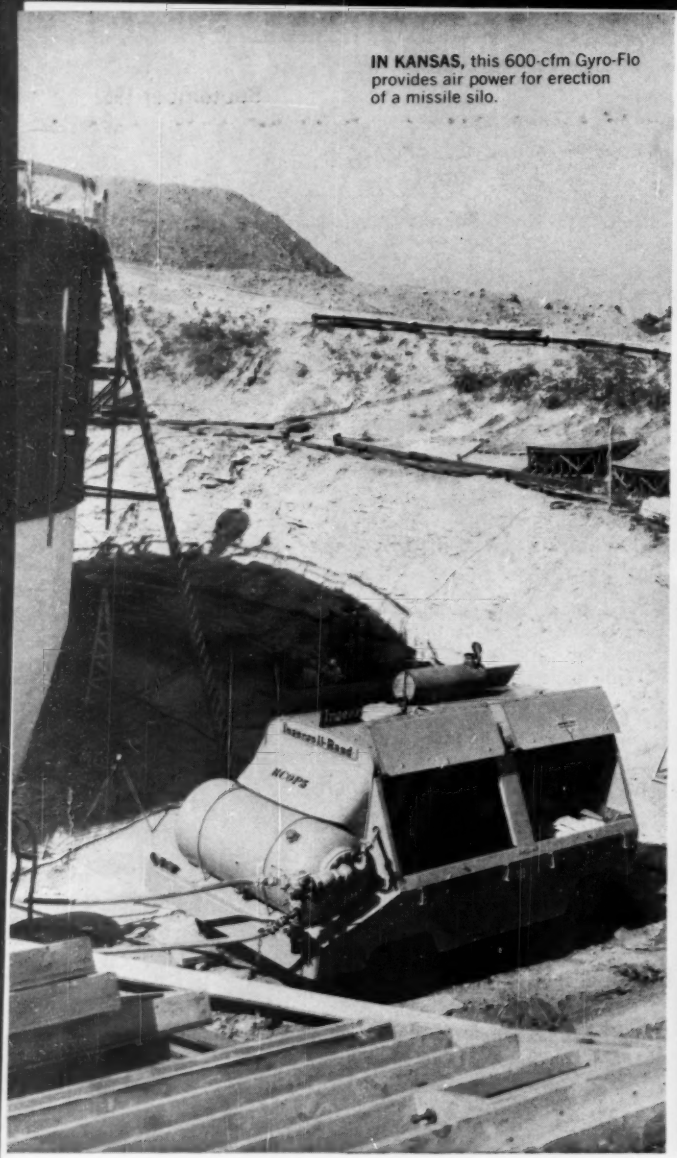
Photo, Lewis-Morgan

on the cover

Somebody once wrote that man is by nature a wave watcher. The endless variations of the sea's surface never lose their fascination. Interest in the sea is at a high pitch today for another reason: man is learning to convert the salty water to fresh and use it for his needs. This is necessary because an expanding and more highly complex society demands more water all the time. Our cover picture was taken at rustic Cape May Point, N. J., where piles and rock breakwaters have been installed in an attempt to thwart the sea's invasion. The photo serves to introduce a series on saline water conversion that starts in this issue on page 18.



IN KANSAS, this 600-cfm Gyro-Flo provides air power for erection of a missile silo.

IN TEXAS, three Gyro-Flo 600s power Crawl-IR drills for a missile launching site.

IN NEW YORK, three 600-cfm Gyro-Flo compressors help break ground for a missile pit.

Why missile-base contractors

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Where schedules MUST be met, there's no substitute for Gyro-Flo... the first and most experienced portable rotary air compressor, pioneered and perfected by Ingersoll-Rand.

Available in sizes from 85 to 900 cfm, Gyro-Flo compressors provide a constant source of 100 psi air month after month, even under the most adverse conditions of heat or cold. Like cost-conscious contractors everywhere, you too can *depend on Gyro-Flo.*

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High Temperature Water vs. Steam
for space heat, process heat, air conditioning

C-E makes *both* types of equipment. Here are the facts:

High temperature water systems are coming into wider use — not only for space heat and process heat applications, but for use with absorption air conditioning equipment as well. Customers have ordered some 80 High Temperature Water Boilers (Type HCC) for these purposes, with plant capacities ranging from 10 million to 300 million Btu/hr, and operating at water pressures up to 500 psi and temperatures to 470F, or higher.

The "Thermal Flywheel"

With a steam system, boilers often have to be operated constantly at full load. Wide load swings can cause loss of steam pressure and considerable lag before sufficient steam can be supplied. But because a high temperature water system has a far greater heat storage capacity than a steam system at the same pressure, even sudden large demands will not drain heat from consuming units. Thus fluctuating demand does not immediately affect boiler loads. Boilers operate at a more constant rate which improves the efficiency of the entire system. In industrial applications, temperature of ovens, tanks, calender rolls, heating platens, etc., can be controlled within close limits, which often results in improved product quality and increased production.

Savings with High Temperature Water

While capital costs for steam generators and high temperature water boilers of equivalent capacity are roughly the same, a system using a C-E Hot Water Boiler can usually save from 10 to 20 percent in operating and maintenance costs:

1. **No steam traps.** This means substantial savings in initial cost, plus further savings by eliminating trap maintenance. Steam losses due to normal trap operation are also eliminated;

2. **No blowdown required.** This represents a considerable loss in steam systems, reflected in increased fuel costs;

3. **No pressure reducing valves.** Initial valve cost is reduced and losses from improper valve regulation are prevented;

4. **No pipe grading required.** The system is always under pump pressure. Piping can be carried over machinery, in roof trusses, up or down grades — even underground. Pipe life expectancy is increased many times since corrosion is minimized in a closed oxygen-free system;

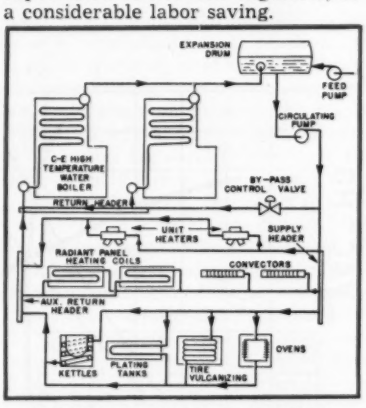
5. **No condensate return lines.** And no investment outlays for corrosion prevention; cost of replacing wet returns is eliminated;

6. **No expensive feedwater treatment.** Since only small quantities of make-up water are needed, treatment can be handled on a batch system basis.

Versatility of High Temperature Water

For heating units such as space heaters, radiant panels, etc., high temperature water may be used directly. For domestic heaters, ovens, tanks, vulcanizing equipment, etc., it can be used indirectly — as low temperature hot water or as steam — produced in suitable heat exchangers.

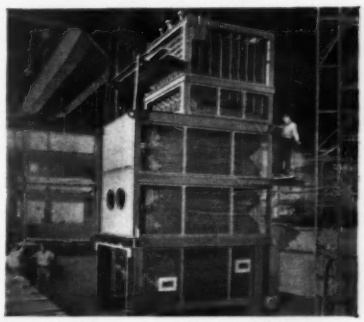
In addition, high temperature water is well-adapted to use in the coils of absorption refrigeration units — for cooling, as well as heating, multi-building applications. Absorption equipment can be located in each building and can operate without the supervision of licensed engineers, at a considerable labor saving.



A simplified schematic arrangement of typical high temperature water applications in industrial or commercial plants. Shown are the Type HCC boiler, expansion tank, circulating pump and actual heat consuming units. Heat exchangers for conversion to low pressure hot water are also used frequently in these systems.

The C-E High Temperature Water Boiler

C-E High Temperature Water Boilers are designed around the same controlled circulation principle used by C-E in many of the world's largest steam generation units. They can be



A 30 million Btu Type HCC boiler partially shop assembled, showing compactness of the unit. Upon addition of refractory and welded casing, boiler will be lifted by its lugs onto a flat car for shipment.

fired by oil, gas, coal or any combination of these fuels. They operate with low pressure loss, provide complete control of system and boiler circulation, and offer optimum arrangement of heating surfaces. All circuits are drainable and headers are accessible from outside the boiler casing. With no baffles in the boiler, there are no areas where soot can accumulate. Symmetrical arrangement of heating surfaces permits a rugged, gas-tight casing construction which can be pressure fired and is entirely suitable for outdoor installations.

The standardized design of these units results in lower first cost, shorter delivery time, lower cost of ownership. Smaller sizes are completely shop assembled, while larger sizes are shipped in component assemblies, to reduce field erection costs.

You be the Judge

Because most operators, engineers and contractors are more familiar with steam than with hot water systems, we have gone to some length to enumerate the major differences between the types. Naturally, needs vary, and the eventual choice of a heating system should be made only after a thorough investigation of all factors.

Our engineers will be pleased to discuss either hot water or steam units, or both, with you and your consultants — impartially and with no obligation. For further details on high temperature water boilers, write for catalog HCC-2.

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CENTRAL VACUUM SYSTEM FOR PAPER MACHINES

Robert James

A RECENTLY introduced central vacuum system for paper machines has many features of interest to mill operators. First, a single centrifugal exhauster handles all vacuum requirements for an entire paper machine. It does this with savings in horsepower of up to 25 percent. Second, the Ingersoll-Rand system returns a bonus of dry, hot air for use in the mill for any of a variety of drying applications. This available heat energy amounts to as much as 70 to 90 percent of the driver input to the central vacuum exhauster.

There are other advantages, too. The horsepower used is proportional to the actual vacuum capacity required—an advantage inherent in the design of centrifugal compressors. The system conserves mill water and provides for white-water recovery. And, the single-machine concept reduces spare parts inventory and maintenance.

Vacuum Requirements

The function of the vacuum equipment for the wet end of a paper machine, of course, is to produce the correct vacuum conditions at each vacuum box, inducing a pressure differential across the sheet to remove the necessary water. The Ingersoll-Rand central vacuum system meets these basic requirements with the following primary components:

Centrifugal Exhauster—used to create the correct vacuum levels while handling all the air drawn through the vacuum boxes.

Separators—to remove the water from the carrying air stream before it enters the exhauster. The separators assure a dry air discharge from the exhauster that can be utilized in other processes.

Controls—to automatically maintain correct vacuum levels at all points under all operating and starting conditions.

Centrifugal Exhauster

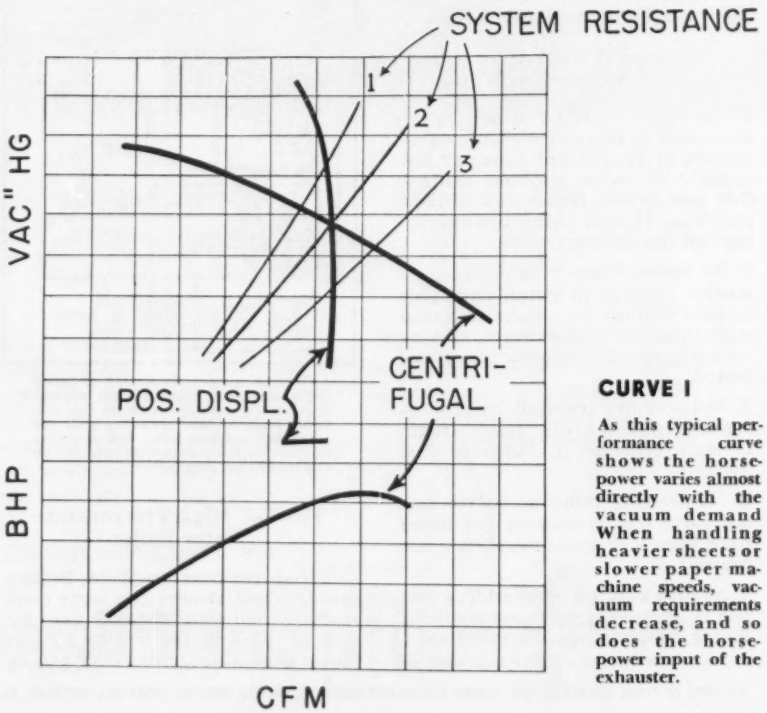
The exhauster is a multistage centrifugal machine with only one moving part—the rotor. The casing is horizontally split and the connections for vacuum and discharge can be arranged either up or down depending on the installation requirements. The machine can be driven either by a steam turbine or an electric motor. (Steam turbine drive is frequently recommended to improve the heat balance because the turbine exhaust can be used for other applications throughout the mill.)

The operating characteristics of the centrifugal exhauster are quite unlike those of a positive displacement vacuum pump. The exhauster is essentially a constant pressure/variable volume machine. As Curve I illustrates, both the vacuum and capacity of the exhauster change as the system resistance (sheet porosity) changes. The positive displacement pump, on the other hand, is a volumetric machine and absolute pressures will vary sharply while the volume changes but slightly. Thus the centrifugal exhauster conforms to normal requirements of changes in sheet porosity. It also saves money by proportioning the horsepower input to the actual vacuum capacity needed.

In addition to handling wide variations in paper machine speed, the centrifugal exhauster can carry extra capacity at constant speed with a minor decrease in vacuum. Turbine-driven exhausters may be designed to handle an even greater range of capacity through an increase in speed.

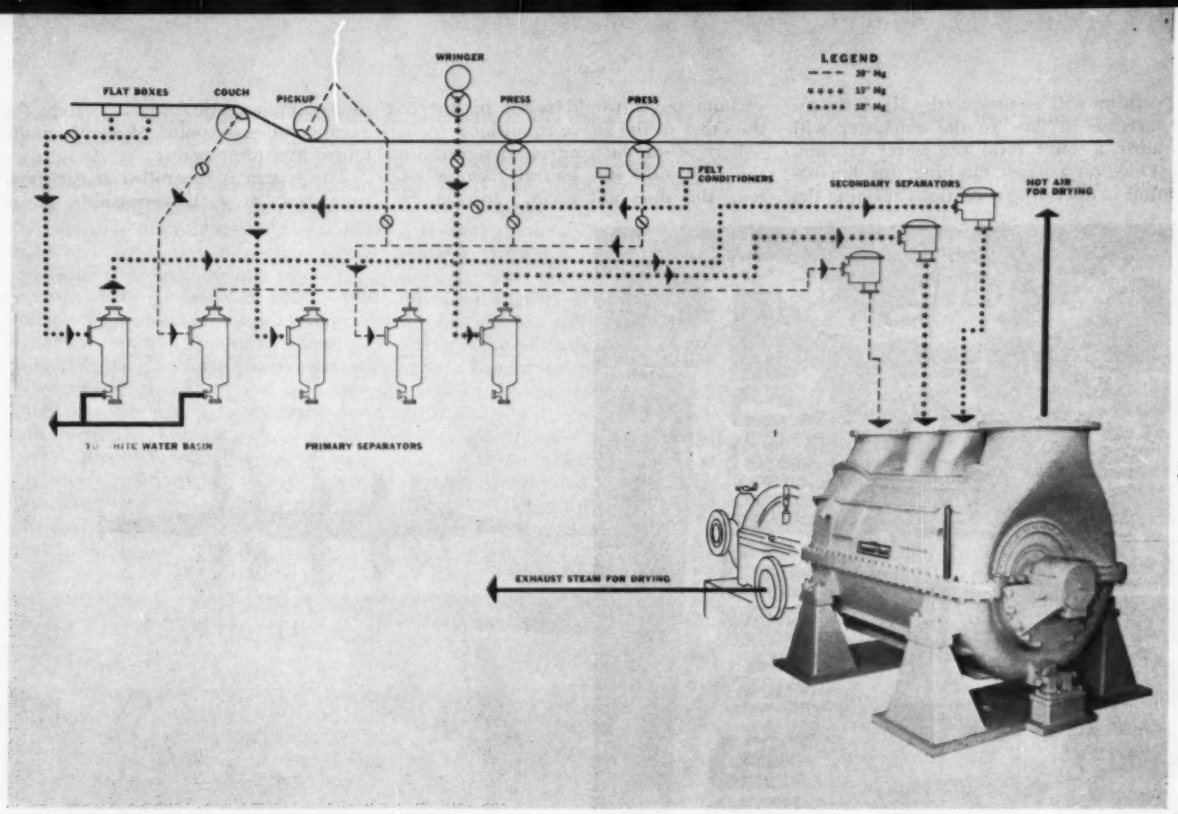
Heat Recovery

The exhauster compresses air in the system to a pressure slightly above atmospheric. The air is discharged at a temperature of about 325° to 350° F. By taking full advantage of this hot discharge air, the equivalent of 70 to 90 percent of the driver horsepower can be utilized for various drying applications. This available energy in the heated air, added to the higher efficiency of the exhauster, greatly improves over-all plant heat rates. Hot air output of a typical unit is 1000 pounds per minute at 330° F when operating at an inlet temperature of 90° F, representing an addition of



CURVE I

As this typical performance curve shows the horsepower varies almost directly with the vacuum demand When handling heavier sheets or slower paper machine speeds, vacuum requirements decrease, and so does the horsepower input of the exhauster.



SCHEMATIC The illustration above shows primary vacuum lines in the Ingersoll-Rand central vacuum system for paper machines. Control valves in each header regulate absolute pressure while still permitting the exhauster to operate within design points. Depending on conditions, a variety of different levels of vacuum can be generated by the machine. Three are shown. The single machine can save to 25 percent of horsepower costs and return a bonus of hot, dry air equivalent to 70–90 percent of driver horsepower. For example, an I-R centrifugal exhauster of 1065 hp can handle all the requirements formerly needing six wet vacuum pumps totaling 1285 hp, or a net saving of 220 hp.

3,000,000 Btu per hour. In addition to saving the cost of steam for heating drying air, the exhauster also eliminates or reduces capital investment for heaters and fans.

Separator System

The basic reason for a separation system is to remove entrained water, pulp and felt hairs from the air stream before the stream enters the centrifugal exhauster. In doing this the system provides the possibility of saving the water for treatment and reuse. At the same time, it assures that the discharge air is clean and usable. The air entering the exhauster is saturated (has 100 percent relative humidity). As it flows through the exhauster, the heat of compression raises the air temperature and the relative humidity is reduced significantly.

Two stages of separation are used. The primary stage usually consists of one or more separators for each vacuum level. It removes the largest amount of entrainment. The secondary stage consists of one separator for each level of vacuum. This final or "polishing" separator handles all the capacity for a given vacuum level.

A minimum number of separators are used, lowering installation, piping and space requirements. Depending on space or operating conditions, services of the same vacuum level can be combined, utilizing common primary separators. Thus, two suction presses, each running at 20 inches Hg vacuum could use the same primary system.

If space permits, the water-removal system from the separators can be barometric drop-legs. Where this cannot be done, centrifugal pumps can be used. The over-all height of the separators has been kept to a minimum for installation in tight quarters. The air inlet and outlet use standard flanged connections. Bolting brackets are located around the base for floor mounting. If barometric drop-legs are desired, mounting brackets can be arranged to suit the installation.

The air and entrained matter drawn from the paper machine enters the primary separators through tangential inlets. The effluent is thrown to the outer wall by centrifugal force and falls to the bottom for removal. The air discharges from the top center outlet pipe that extends into the separator tank. The bottom of the separator is baffled to prevent a vortex forming at the suction when pumps are used for water removal. For ease in inspection and cleaning, a quick-opening manhole cover is provided. A shower ring at the top of the separator is for fresh water washdown.

The secondary separator is designed to remove additional entrained droplets of water from the air stream by centrifugal separation. The separated water can be drained to one of the primary separators for removal, or a separate removal system can be provided. Air is discharged from the bottom or top of these "polishing" units.

Control System

The control system is designed to maintain a steady and instantaneous source of vacuum automatically under all normal operating conditions, including sufficient vacuum at flat boxes and the couch roll during a paper break so that operation need not be slowed or stopped because of lack of vacuum.

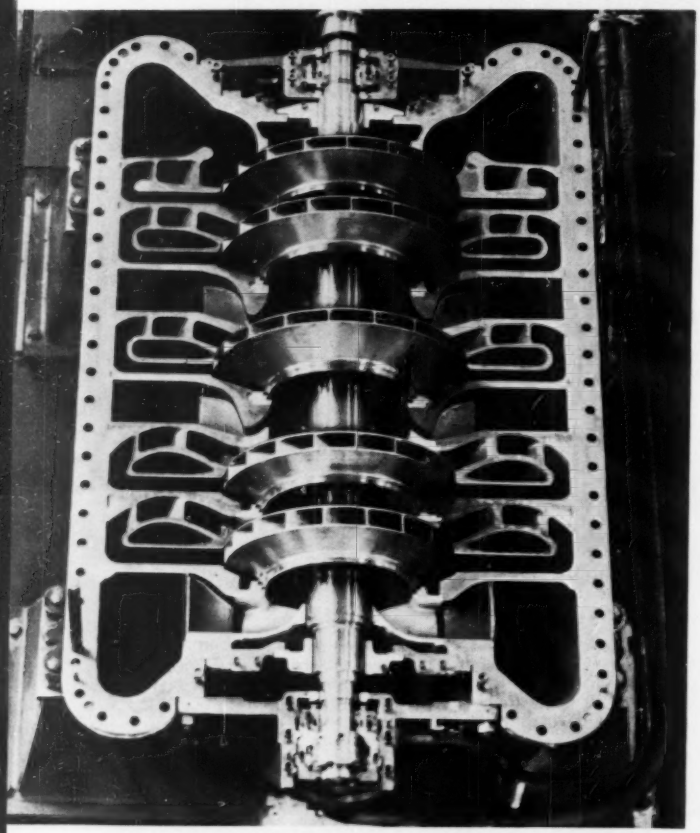
The centrifugal exhauster by itself has a flat vacuum-volume characteristic, with rising vacuum at the low capacity end, and decreasing vacuum at capacities beyond the design point.

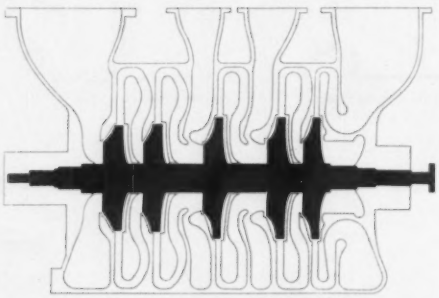
As the flow decreases in a header to a centrifugal exhauster without supplemental control, it will generate a higher pressure ratio. This means that a higher

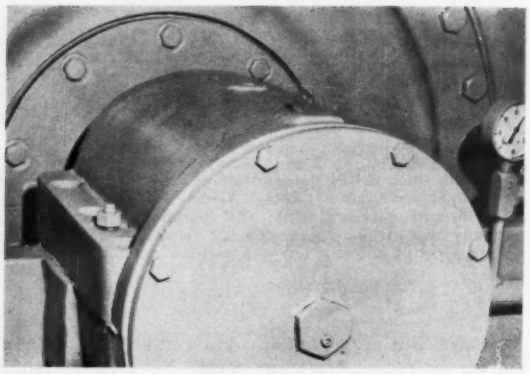
vacuum will be produced. Similarly, an increase in flow to the exhauster will mean a lower ratio and lower vacuum. Thus, on a paper machine, any fluctuation in operating conditions affecting the vacuum boxes would result in one or the other of the above conditions.

Because of the controls designed for the Ingersoll-Rand central vacuum system, this does not occur. Instead, by means of automatic throttling valves, the vacuum at each point of use is maintained at a preset value.

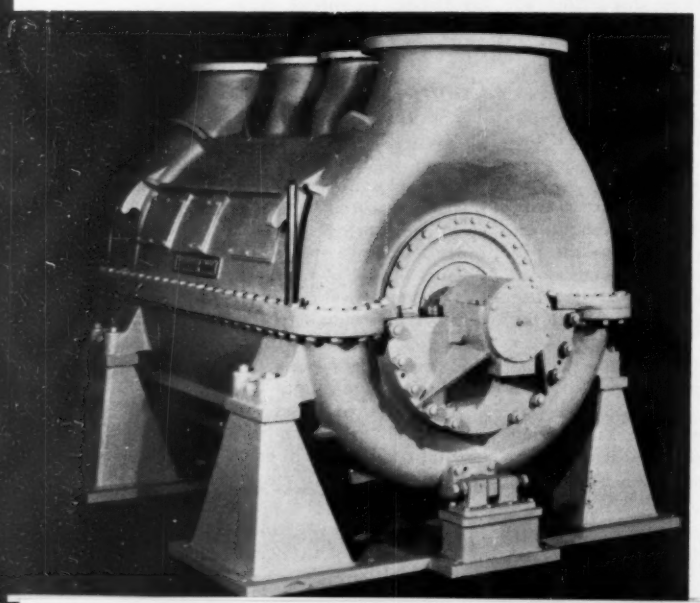
The system is controlled at each vacuum box, or each permissible set of







Design Features and Test Installation



ON THIS PAGE At top, left, the dismantled machine shows the horizontally split housing and the single moving element—the rotor. A simplified cross-section of the exhauster is drawn above. Bearing boxes are outside the air flow passages, assuring that no lubricating oil can get into the discharge air stream. The hot, dry discharge then can be used without danger of contaminating even the finest papers. The centrifugal design operates without inherent unbalanced forces. Immediately above is a picture of a nickel balanced on edge on the bearing housing, while the machine is running. This smooth-running characteristic means the unit can be installed in many locations that would be unsuitable for other types of vacuum equipment. At the immediate left is a view of the exhauster showing the removable inspection plates that are located on one side of the top-half casing. The connection in the foreground is the 20-inch Hg vacuum service line. The bearing housing pictured above corresponds to the one in the center foreground.

ON OPPOSITE PAGE During a week in early August, Ingersoll-Rand showed more than 150 members of the paper-making industry the unique capabilities of the new central vacuum system. The scene was this elaborate test installation at the firm's Phillipsburg, N. J., manufacturing and testing facilities (bottom). The whole range of paper machine operations, from start-up through normal operation to a paper break, could be simulated. During each test, instrument readings throughout the system were posted on the panel shown top left. Thus industry executives could see for themselves exactly how the automatic control system maintains requisite pressures at all points. For purposes of the demonstration, a clear plastic viewplate (top right) covered one of the inspection ports in the machine. The efficiency of the separator system was shown by the fact that no water entered the centrifugal exhauster.

boxes. To minimize reaction time, the control points are located as close to the vacuum boxes as possible. The system works this way for changes in flow within the design capabilities of the exhauster:

An absolute pressure transmitter senses an increase in suction box vacuum. It signals the vacuum controller where it is compared with the set point of the controller. The exhauster has produced the higher vacuum by virtue of its operating characteristics. To lower the vacuum to the correct level, an artificial resistance is put into the header to maintain constant vacuum. The vacuum controller sends a proportional signal to an actuator which positions the throttle valve. Thus any decrease in the flow to the exhauster will not result in higher vacuums in the boxes. The higher vacuum exists only in the header of the inlet to the exhauster.

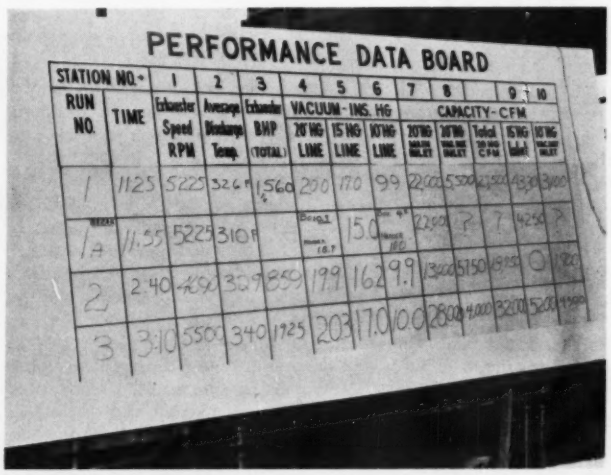
If conditions require higher vacuum at the boxes, the controller is reset to the necessary levels.

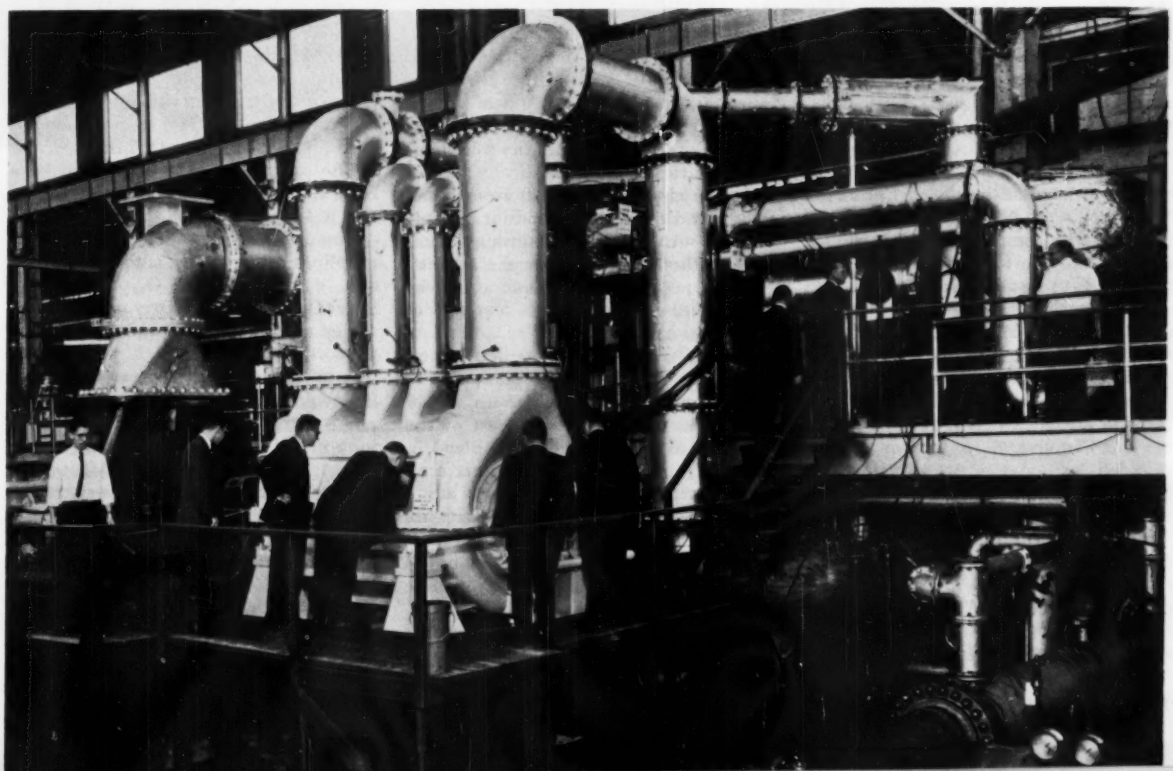
If the absolute pressure transmitter senses a reduction in suction box pressure, the same procedure occurs to open the throttling valve, increasing the flow through the box to increase the vacuum. Further, the controls are flexible enough so that conditions at the vacuum boxes can be easily adjusted to any level within the capacity of the exhauster.

In the event of a paper break, the resistance to flow offered by the sheet is abruptly diminished through the press section. The control system, however, immediately senses this, throttles the valves at all the affected locations, and thereby maintains the requisite vacuum at the flat boxes and couch roll. Operation need not be slowed or stopped becasue of decreasing vacuum at the "wire" services.

During start-up or shutdown different conditions prevail. The control system maintains constant vacuum in the main headers providing an instantaneous source of vacuum as soon as the sheet passes over the suction boxes. The controls are also tied into the operation of the pickup roll (and, in some cases, the first press roll) to provide on-off vacuum control during start-up and sheet breakage.

Thus the Ingersoll-Rand central vacuum system requires a minimum of attention from start-up to shutdown. Full vacuum is maintained at all times.





A.O.G. The initials stand for "aircraft on the ground," a subject of some concern to all airlines. The huge investment in jet aircraft means that rigorous maintenance procedures must be speeded to keep the planes in the air and producing revenue. The tall tail of this jet requires hinged opening over hangar door for clearance.

E. G. Dickson

Keeping Jets Aloft

JET AIRCRAFT have revolutionized passenger flights. They go farther faster than the piston planes they have all but replaced on long-haul routes. They also cost a lot more, which means that commercial airlines must keep them in the air to bring in revenue to pay off the huge investments.

In all phases of airline operation, new ways are being sought to cut unprofitable time on the ground. Thus, with the revolution for the passenger has come a behind-the-scenes revolution for the men who keep the jets flying. Maintenance policies and methods have had to be dovetailed with jet speeds and capacity.

Compressed air power has been harnessed at Pan American World Airways' Base, Miami, Fla., to speed maintenance procedures. The sprawling installation at Miami International Airport does maintenance and overhaul on air frames at Pan American Field. The Component Overhaul Base, across the airport, takes care of component parts of the aircraft. (Repair and service of the powerful jet engines is handled by the airline's New York facility.) At both the air frame base and the component service center, facilities are provided for complete testing as well as inspection.

Pan American has set up a methodical point-by-point, part-by-part examination of aircraft coming in for service. When one of PAA's speedy jets is grounded for periodical maintenance checks, it is located in one of two giant hangars (Number 6 or Number 7), jacked up and surrounded by docks or work scaffoldings that permit ready access to all parts of the craft.

Then the airplane is gone over and every part checked for operating deficiencies, for any signs of potential mechanical trouble, and for any adjustments or repairs that can be quickly performed on components while still in place on the aircraft. Operating hours of each component are registered, and those that have reached their maximum service are removed along with any requiring extensive overhaul. These are sent to the Component Overhaul Base. Air frames too, have operating limits, and when these are reached, they are completely inspected both internally and externally.

For each of the two maintenance depots at Miami, PAA engineers have installed elaborate compressed air facilities to power accessories and to turn over jet engines. The need for air power may be traced to the advent of the turbo-jet engine. Designers found a ready-made source of power for many aircraft functions in a stream of compressed air bled from the engine compressors. For example, the refrigeration system on the Douglas DC-8 is pneumatically powered. As much as 15 tons of refrigeration is required from units on each side of the big airliner.

In the pre-jet era, auxiliaries were powered electrically or hydraulically. Feeding electricity to the aircraft from standard ground connections made it possible to put such auxiliaries through their paces without turning over the engines. And, if necessary, the plane could be given a full ground check by a run-up of the piston engines.

Testing of the jets presented a new problem, however. If the plane was to be checked by an engine run-up, it had to be done at some remote part of the field because of the danger involved in running the engines in the hangar area. Thus compressed air to operate auxiliaries had to be supplied for maintenance work. A means of "motoring" or turning over the engines with ignition was also required and this job, too, was one for compressed air power.

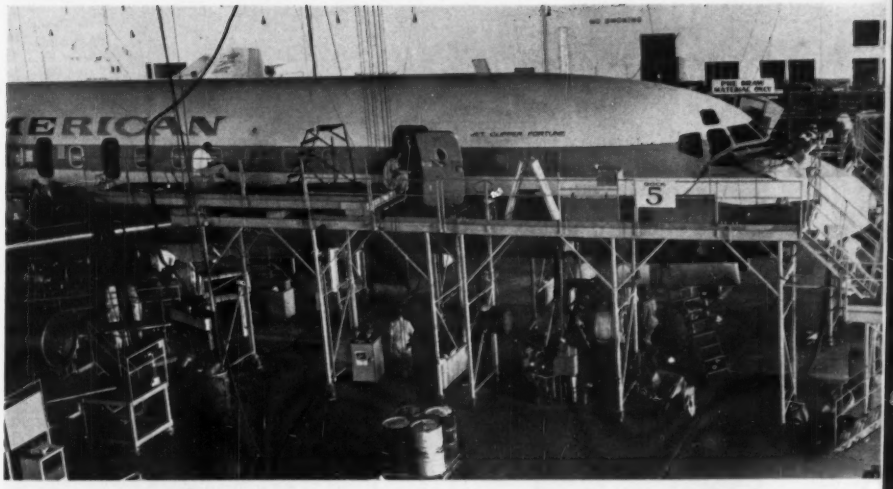
Thus, the air systems used by PAA provide a thorough functional check of all the air-powered or air-activated components of the plane, and an over-all operational test, both of which can be performed in the hangars.

At Pan American Field, in a room between hangars 6 and 7, a $75,000 air supply system is installed. The 2-stage air plant is a pair of Ingersoll-Rand Axicompressors, the first stage being a 105x21; the second, a 900x16. In the first stage, air drawn through a Burgess-Manning intake filter is compressed to 14.8 psig and passed through an intercooler to the second stage. There pressure is raised to 45 psig and discharged at 335° F. Valving in the discharge line permits routing the air through an aftercooler, or bypassing it directly to headers. If aftercooled, the air is passed through a Ross moisture separator with automatic trap. Whether hot or cool, the air then passes to a 6-inch header, through a check valve, and then underfloor to "islands" near hangar docks. Hot lines and underfloor piping are thermally insulated.

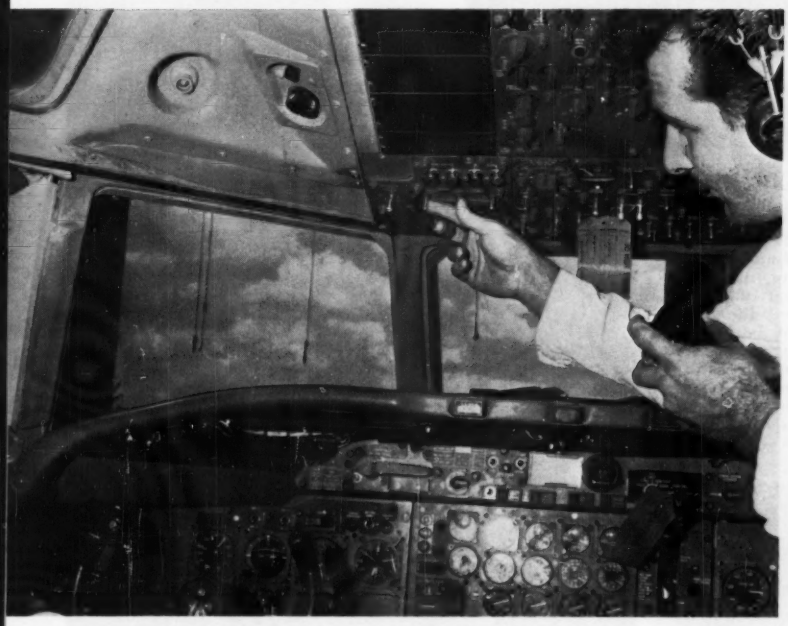
The compressors are belt-driven by a D397 Caterpillar diesel delivering 500-hp (on a 1-hour basis) at 1200 rpm. The driven pulley, mounted on Thomas couplings between the tandem compressors, carries eighteen Type D Gates Super-Drive V-belts. Driving to driven pulley ratio steps up speed of the compressors to 1775 rpm.

A special water system was installed for cooling the compressors, inter- and aftercoolers, and the heat exchanger serving a closed circuit cooling system on the Cat engine. Supplied by a 100-foot deep, 8-inch well, water is fed to the system by a 5-hp pump.

The engine is installed on a movable base to facilitate belt installation and tensioning. Diesel fuel is stored in a 1000-gallon tank and drawn by a $^1/_4$-hp pump to a 5-gallon day tank feeding the engine fuel pump. Return lines are re-



AIR FRAME Mechanics swarm over PAA Jet Clipper "Fortune" in work docks during overhaul of air frame and components. Island from which compressed air is supplied to plane is shown just below forward cockpit. At right, below, is a close-up of reinforced 3-inch hose as mechanic couples it to manifold in nose of aircraft. On some jets, manifold is amidships. In the cockpit, below, an electrician checks for any instrument indication of malfunctions while components are running on exterior air supply. Functional tests such as this show whether or not components must be removed for repair or overhaul.



quired, and all piping is under floor. The engine is cranked with an I-R Air Starting Motor supplied with 100-psig shop air. Exhaust is piped through an 8-inch line to an out-of-doors muffler and thence up the side of the building, through the roof overhang, to atmosphere.

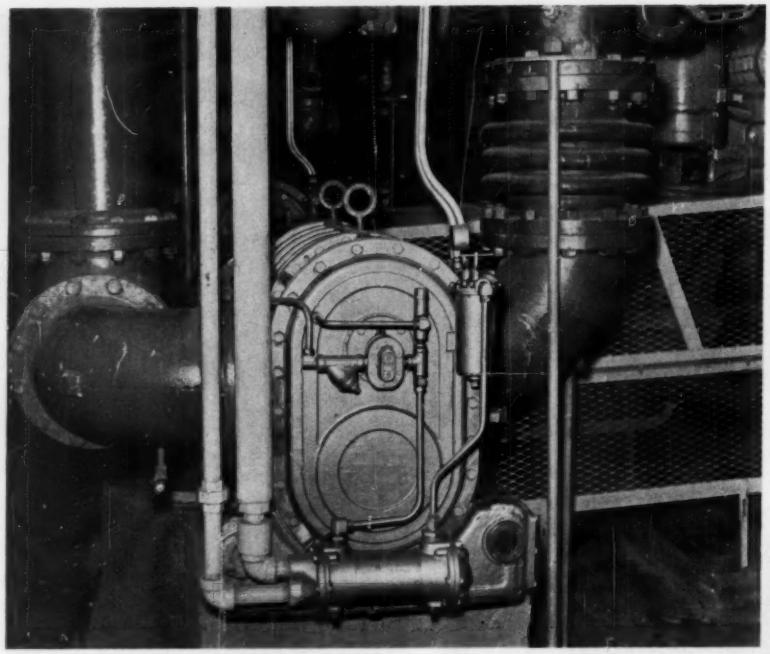
The entire compressor installation is compactly housed in a 17 x 22-foot room with 16-foot ceiling. For surface cooling the machinery, and to supply the indoor compressor and engine intake filters, 22,000 cfm of cooling air is supplied by a 48-inch intake fan. Across the room from the fan, an exhaust hood vents the air into the adjacent hangar. The footings for the compressor and engine extend 30 inches below the original 6-inch concrete floor.

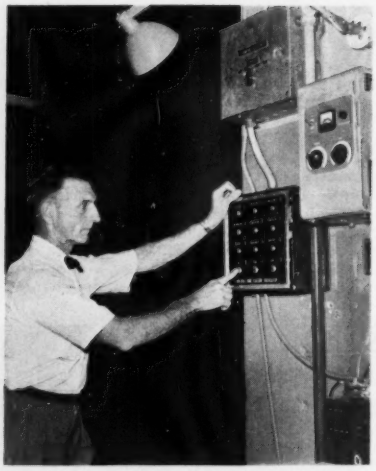
The Axi-compressor rotors run with small clearances with no metal-to-metal contact and require no compression-chamber lubrication, thus assuring a clean, oil-free air supply for the test work. Air leaving the compressor room splits into a pair of 6-inch headers, each supplying, as indicated, an island near work areas. The islands are each about 200 feet from the central compressor station.

The air system valving and control equipment was selected to meet the somewhat unique requirements of the testing work, and to safeguard the compressor installation as well as mechanics at the aircraft. Controls are electrical and are fed by a 24-v d-c battery.

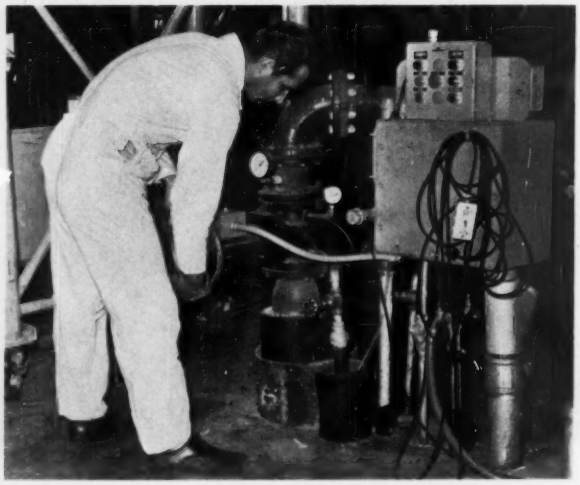
Compressors are started in the compressor room itself; thereafter, they may be loaded, unloaded or stopped from one or the other of the islands. The system starts only with both stages unloaded. Normally-open Johnson pneumatic diaphragm valves are used, a 4-inch valve on the first stage, and a 5-inch valve (which also regulates pressure in the discharge line) on the second stage. Compressor house controls include start, stop, and operating-failure-shutdown switches, the latter keyed to indicating pilot lamps. Valving is designed so that only one island at a time is supplied with air, the selection being made only from the compressor room. Prior to starting, outlet valves at both the service islands must be closed and thereby locked.

After starting, the proper valve is opened to the island requiring air. Then, at the island, a 3-inch hose is run to a single manifold connection on the plane which distributes air throughout the craft as required. The valve to the





AXI AIR SUPPLY The 2-stage installation at the Air Frame base is shown above. In the foreground is the second-stage 900x16 unit; the one in the back, a 105x21 is the first stage. At left is the 500-hp Cat diesel driver. Eighteen Gates V-belts run under expanded metal guard to drive the tandem Ingersoll-Rand units at 1775 rpm. Control panel in the compressor room, shown at right above is only point at which units can be started. Pilot lamps on panel indicate location of system failures if automatic shut-down switches are actuated. Compressors may be loaded, unloaded and stopped from island control panels (right) 200 feet away. Hand valve being opened by attendant must be fully open prior to loading compressors. Hanging on hook at left of panel is extension cord with its "panic" button. Air is delivered to island at 45-psig pressure and is reduced to 40-psig for use in the craft.



"FEEL" TEST Leaks in lines can be located by "feel" test as shown in this view when plane's pneumatic system is charged with 40-psig air. Tests such as this are impossible to perform when jet engines are running. Under the PAA system, the electrical crew runs the functional tests—on this DC-8 jet, most of the valves are pneumatically operated and electrically controlled.

flexible connector is then opened (all the way, before loading can be done) and a button switch on the island control panel pushed to load the compressors and supply air to the craft.

In addition to the load/unload and stop switches at the island, a "panic" button is provided that immediately unloads and shuts down the compressor installation. The emergency shutdown switch has a 50-foot extension so that mechanics at the aircraft can keep it handy.

Downstream of the check valving (which prevents back pressure on the compressors and reversal of rotation), an automatic bleed de-pressurizes the long header whenever the system is unloaded or shut down.

The air system has two functions. Delivering air to turn over engines without ignition is one. This motoring gives mechanics a chance to inspect the entire craft for malfunctions in fuel or hydraulic lines under conditions similar to actual flight. Instrument readings during this procedure tell the tale—they show if the various functions of the systems are up to flight requirements.

In addition, the air supply, which is of ample volume to pressurize the entire plane system, provides a means of running an effective functional test of all air-powered auxiliary equipment on the aircraft.

The air entering the plane is reduced in pressure to 40-psig, corresponding to the plane's own air supply. Thus PAA maintenance crews can simulate actual operation, checking through all parts normally air activated or driven. On the Douglas DC-8's, for example, the Freon compressors for the refrigeration system and the cabin air compressors are both air-driven. The injected air supply lets mechanics check these completely, including leakage tests of valves, lines and ducts. Instrument readings show whether compressors are working properly. Similarly, the plane's de-icing and ejector systems can be examined. Normally the ejector system, which provides braking through engine thrust reversal, is hydraulically actuated, but it has pneumatic power as an alternate source.

Maintenance on PAA's Boeings—the

PART OF PAA MAINTENANCE FACILITIES AT MIAMI INTERNATIONAL AIRPORT

BENCHES AND STANDS At well-tooled benches, such as this one above, components of PAA's Clipper jets are torn down, inspected and rebuilt to factory and airline standards. Then, to assure that they meet these rigorous requirements, each is checked on a test stand similar to the one shown at right. The equipment under examination here is a cabin-compressor turbine valve from a DC-8. The test stand was manufactured by Paul-Monroe Company for Pan American.

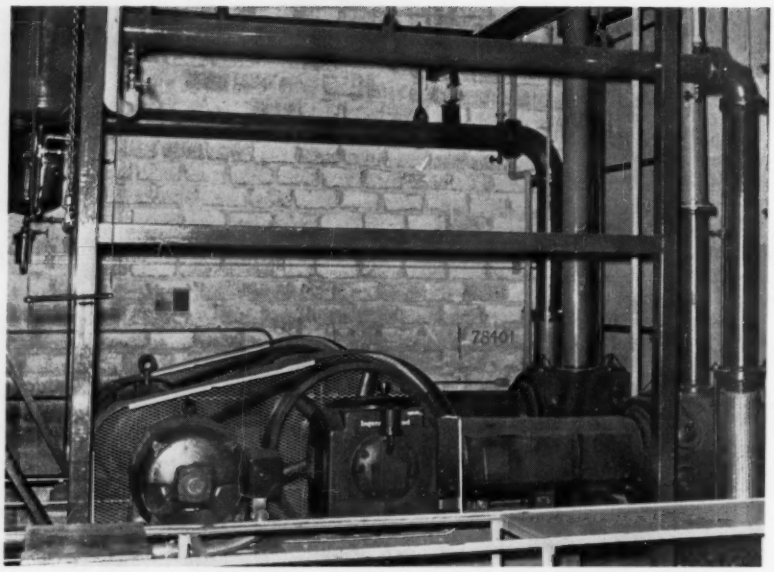
707, 121 and 300 series—is similar, with the air supply being used to motor engines, to check refrigeration, cabin-pressurization and anti-icing equipment. Although these tests are not exact—do not completely simulate all flight conditions—they are functional checks that point up deficiencies that may require a component to be removed from the plane for adjustment or repair.

In such a case, the equipment is taken to PAA's Component Overhaul Base to be torn down for examination, repair and reassembly according to factory and airline specifications. Tests of this exacting work also require considerable quantities of compressed air and call for the second of PAA's specialized air systems.

The Component Overhaul Base air plant consists of a pair of I-R nonlubricated ESH compressors, one of 125-hp rating, and the other, 150-hp. The smaller unit is a 15 x 11-inch machine operating at 55-psig discharge pressure. The larger one is a 17x11-inch unit, delivering 75 psig. Both are driven at 1150 rpm by Century motors of appropriate ratings.

For much of the work, air at the lower (55-psig) pressure is suitable, and is supplied by the smaller compressor operating alone. But, for some tests, greater pressure is required. In such cases, or when greater volume is needed for standard checks, the second compressor is started. The twin-unit installation thus also provides stand-by capacity.

The machines discharge to PL (pipeline) aftercoolers and thence to a 12-foot x 48-inch receiver. From the receiver, air lines run overhead to the test stands of the overhaul shops for use in checking out repaired, rebuilt or adjusted components prior to their being reinstalled.

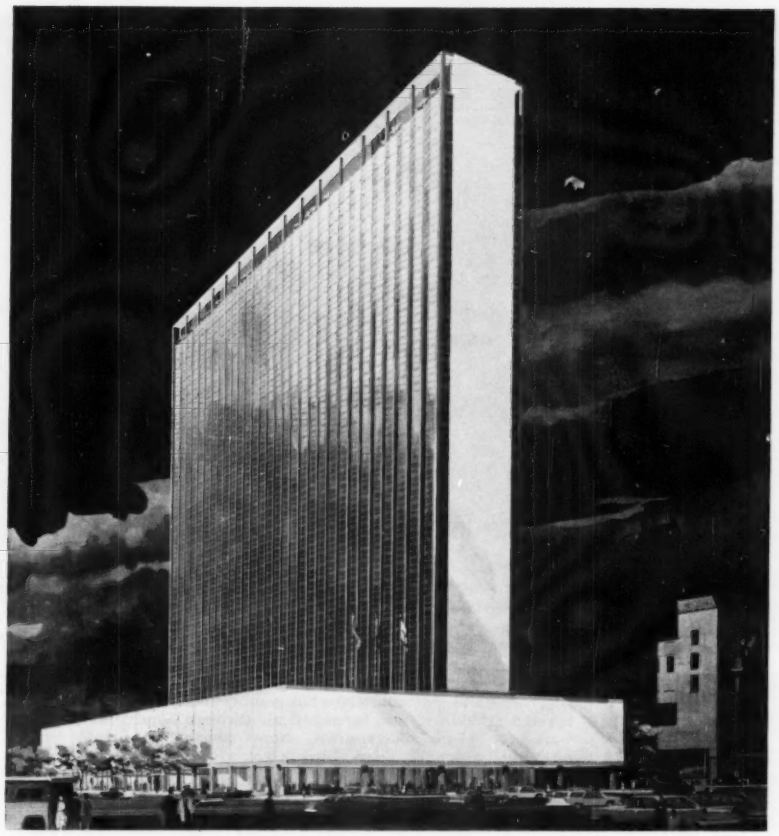


C.O.B. AIR PLANT Compressed air for the Component Overhaul Base is supplied by these ESH-NL (nonlubricated) compressors. Both machines have 11-inch strokes, the one in the foreground having a 17-inch cylinder and being driven by a 150-hp motor; the one in back, a 15-inch cylinder and a 125-hp driver. The large Ingersoll-Rand machine is rated at 75-psig delivery pressure, the smaller one at 55 psig. Each discharges to its own overhead pipeline aftercooler.

When reciprocating engine planes made up the PAA Clipper fleet, the carrier developed an assembly-line overhaul program that resulted in stockpiling engines as well as other basic components, ready for quick installation as required. But the high cost of engines and components for the jet fleet has made such a system impractical today. The accent now is on fast, but careful adjustment, repair or replacement and on thorough testing aimed at getting the plane safely back into the air as soon as possible.

Compressed air power thus becomes a vital hangar tool for Pan American in ways different from its traditional use in pneumatic tools for assembly and disassembly. The cost of the systems is expected to be repaid quickly out of savings in the time aircraft have to remain on the ground.

JET CLIPPER "FLYING CLOUD" AT 35,000 FEET OVER PACIFIC OCEAN



"A Room with a View"

Peter Sleight

MILES of scaffolding and steelwork veil New York as she undergoes her constant face lifting. One journalist has said that on Park Avenue alone there are more hard hats than homburgs. Over on Sixth Avenue, between Fifty-Third and Fifty-Fourth Streets, New Yorkers can see another current excavation. By October they will be able to view more of the omnipresent steelwork.

The hole is for the foundation of one of the dozen Hilton hotels under construction in the U. S. and abroad. The New York Hilton at Rockefeller Center is due to open the first week of 1963, and by the yardstick of total rooms, will be the fourth largest of this vast organization. Plans call for 2165 rooms, including a possible combination of 574 suites.

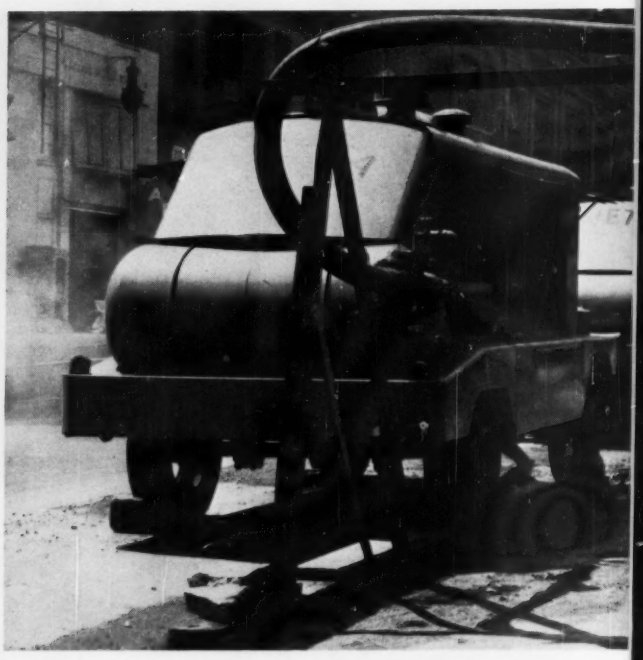
For the statistically minded, the largest of the Hilton hotels is The Conrad Hilton, Chicago, Ill., with 3000 rooms, followed by The Palmer House, also in Chicago, and The Statler Hilton in New York. Competing for anchor position are the Hilton Inn, El Paso, Tex., and Acapulco, Mexico's Las Brisas Hilton, each with 150 rooms. When all the domestic and international hotels and inns under contract and construction are completed (target data: 1963), Hilton Hotels will have a total of 42,368 rooms.

The New York Hilton at Rockefeller Center fronts along the west side of Sixth Avenue, extending 450 feet along W. Fifty-Third Street, and along W. Fifty-Fourth, 462 feet, 6 inches. Once the site was littered with 4- and 5-story brownstones. Now the 92,000 square feet is under long-term lease from the Astor Estate. A $30 million loan has been arranged with New York Life Insurance Company by Rock-Hil-Uris, Inc., the owning company for the hotel. Under terms of the agreement, Hilton will manage the hotel and will purchase a 25-percent equity in the venture. Estimated value after construction and furnishing, exclusive of land which is leased, is $75 million.

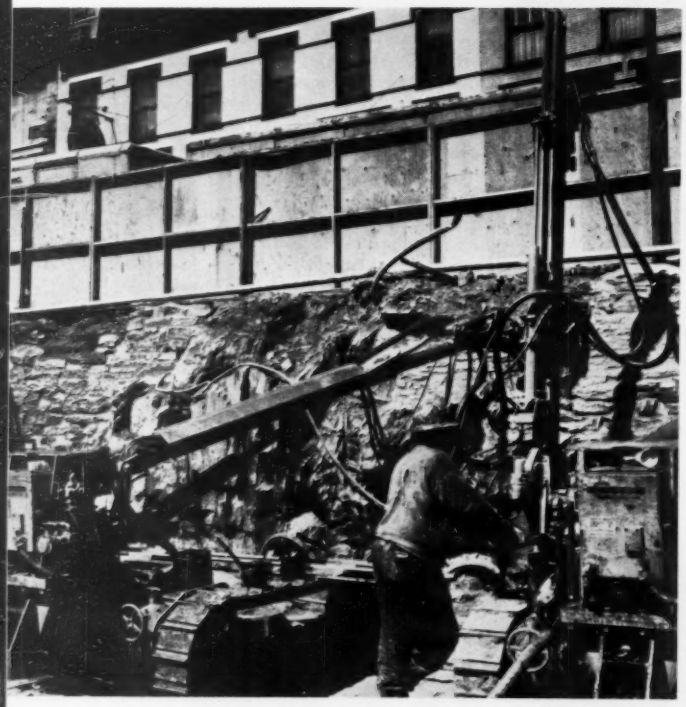
The building will be 45 stories above grade, towering 487 feet over the street. Forty of the stories will contain guest rooms, each with an outside view of the skyline. The 5-story podium on which this tower will rest will contain public areas—lobby, ballrooms, restaurants and the like. Masonry, glass and steel are the construction materials.

William B. Tabler, internationally known for his hotel designs, is the architect. Incidentally, he has just completed the Hilton hotels in Pittsburgh, Pa., and Dallas, Tex., and is currently engaged in work connected with The San Francisco Hilton Hotel. David P. Dann is the associate in charge of the project; Harrison & Abramovitz are consulting architects.

SIDEWALK SUPERS VIEW General construction activity at the hotel excavation site. Note crawlers working in line hole drilling in background.

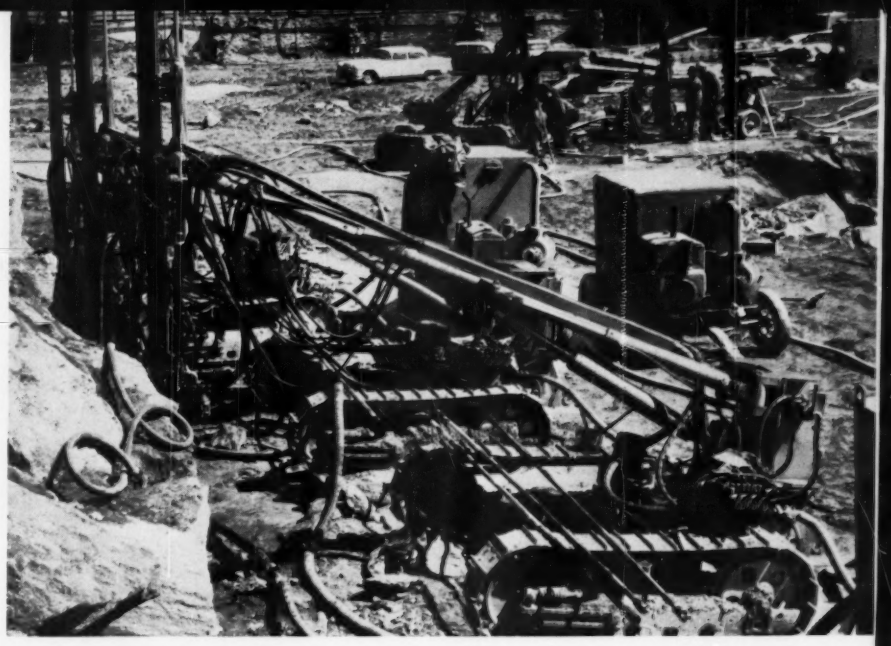


BATTERY To furnish air for the massive excavation job, six Ingersoll-Rand portable Gyro-Flo compressors were used. Each is rated at 900 cfm and furnished air through 6-inch hose to the worksite. These rotary units, shown above and below, were positioned along W. Fifty-Third Street.



EXTENDABLE BOOMS Above, a side view and rear shot of the four Crawl-IR's equipped with extendable booms. These permitted the contractor to drill 40 line holes (20 on each side of the crawler unit) with each positioning of the unit. Holes were spaced 6 inches apart, were 3 inches in diameter, and averaged 30 feet in depth. Blasting was done with 40-percent gelatin powder, and line holes acted as shatter holes to give a smooth break in the mica schist.

COMPARISON At right, in foreground is a standard CM-2 Ingersoll-Rand crawler. Behind it are two of the CM-2's equipped with extendable booms. The increased working capacity at each position is obvious when the arc inscribed by the working ends is visualized.



EQUIPMENT Four of the ten CM-2 Ingersoll-Rand Crawl-IR's were equipped with extendable booms. These are shown in an over-all view above, as well as in other photographs on these pages. Notice the two Foundation Equipment Company dust collectors just to the rear of the drilling units. Behind these, and to the right, are two type FM-2 Wagondrills.

As indicated by the name of the operating company—Rock-Hil-Uris—the project is a joint venture of Uris Buildings Corporation (also the builder), Rockefeller Center, Inc., and Hilton Hotels Corporation. The contract was awarded by Harold D. Uris, president of the building concern, in March 1961. Civetta Excavating, Inc., is the subcontractor for excavation work, with Ted Civetta, Guido Civetta and Joe Lisi, the general superintendents. All work is under the general supervision of Uris field director George Hayes.

If you were a sidewalk superintendent you would have noticed much standard excavation and earthmoving equipment at the site. For drilling, the contractor used eight Ingersoll-Rand Wagondrills and twelve Jackhamers. These were complemented with ten Crawl-IR's.

But the wide-awake "super" would have seen more than this. He would have noticed that four of these Crawl-IR's were unique. They have extendable booms and are relatively new in the construction business. Their big advantage is that they can drill many holes before they must be repositioned. They are simply moved into drilling position, the boom is extended fully to, say, the left, and the first hole is put down. This continues without moving the unit, across the front of the Crawl-IR, until the furthermost right hole is put down. Then the entire unit is moved on its track mounting to the next position.

Thalman Equipment Corporation, the Ingersoll-Rand dealer that supplied the units, reports that the contractor was able to put down 40 line holes with each positioning of a Crawl-IR—20 holes to the left and 20 more to the right. Each hole averaged 30 feet in depth. Line holes were spaced on 6-inch centers, so the Crawl-IR's could put down 1200 feet of hole in a row about 20 feet long before they had to be moved. Drilling was done with Ingersoll-Rand Type 60 bits and totaled 40,000 feet.

All holes were 3 inches in diameter and were used as shatter holes because of the explosive restrictions placed on the contractor in that part of the city, and because the resulting blasted face was relatively smooth, forming a firm support for later concreting. Blasting was done with 40-percent gelatin dynamite. Only one shift was used. The depth of the excavation is about 60 feet. Some 125,000 yards of mica schist had to be removed, the shovels for the most part being Northwest 80D's. Furnishing air was a battery of Ingersoll-Rand portable rotary Gyro-Flo compressors each rated at 900 cfm. The photographs on these and the preceding page give you a sidewalk superintendent's view.

RESPONSIBLE Owner of Civetta Excavating, Inc., John Civetta (right) stands next to Guido Civetta, superintendent. At left is superintendent Joe Lisi.

Photo, Dept. of the Interior

SALINE WATER CONVERSION

The Urgency

S. M. Parkhill

Till taught by pain
Men really know not what good water's worth,

said Lord Byron in *Don Juan*. Today we are feeling the pain, and we are realizing the cost of providing usable water for our luxuries and needs. Few spots on earth will escape the critical shortage, which some now predict may arrive in the 1970's. The situation is becoming especially critical in highly developed countries such as the U. S., where more water is used and wasted than anywhere else.

Water consumption is increasing at an alarming rate for a variety of reasons. There are more Americans born every minute than decades ago, and their life span has been extended to nearly four-score years. Constantly improving is the living standard, many facets of which use water—swimming pools, garbage disposals, dish washers, multiple-bathroom homes, etc. With this rise in the standard of living is an attendant growth of industrial activity to produce the goods we "need." The following table* shows the U. S. average daily water consumption for the past 60 years, and projects it for the next decade and a half.

1900	40 billion gallons
1910	66
1920	92
1930	110
1940	135
1950	203
1960	312
1970	405
1975	453

At present, the largest user of water is agriculture. Some 650,000 gallons per acre are needed to produce a grain crop. The 2-pound steak you had for dinner represents 7500 gallons of water consumed. In short, agriculture accounts for about 50 percent of the total water consumption.

Next largest user is industry. Its share is 40 percent. Heaviest consumers are mining, and chemical, plastics and pharmaceutical plants. Chemical plants alone require a daily average of 17 million gallons, and to manufacture a ton of newsprint consumes 240,000 gallons.

Municipal uses account for the majority of the remaining 10 percent. Some 50,000 gallons a day are required for a 15-story apartment building housing 1000 people in 300 living units. A 1-family house accounts for some 550 gallons a day for every four people living in it. Your 20-story office building, with about 200 persons per floor, saps another 120,000 precious gallons a day.

In 1960, according to the foregoing table, estimated water use was 312 billion gallons daily. This is 60 percent of the relatively constant, readily available natural supply of 515 billion gallons. Local and regional shortages become more and more common as this percentage climbs. By 1975, use will be 88 percent of the available supply.

Some areas are already feeling the pinch—Texas, Southern California, Arizona and New Mexico. The U. S. Geological Survey of 1957 indicated that 1000 cities and communities throughout the States were forced to curtail water use. The same study indicated that out of every 100 people, 15 had to restrict their normal use. Shortages were prevalent in 47 states. During this crisis, residents of Dallas, Tex., stood in line long hours for water, and when they finally got it, the 50-cent-a-gallon cost was twice the local price for gasoline.

What is being done to conserve and increase the natural water supply? Cloud seeding is one proposal, but it is still highly experimental. Covering reservoirs with evaporation retarders such as cetyl alcohol is also being tested. Dams are being constructed and artificial waterways are being made to tap unused rivers, but cities find they must go farther and farther away to find enough water. Los Angeles, Calif., taps part of its supply from the Colorado River, some 500 miles distant.

Antipollution measures on all levels of government have been more strictly enforced. Industries are conducting research on water reuse. Flood and erosion control, and prospecting for underground water courses play their roles in the struggle, too.

Perhaps the most active and promising research is in the field of water desalting. It is centered in the Office of Saline Water, a part of the Department of the Interior. The OSW was created by

* Water and Sewerage Industry and Utilities Division, BDSA, Dept. of Commerce.

Congress in 1952 and has a $10 million authorization for research and development, and a like sum for construction of demonstration plants. Although there are only 27 employees, it coordinates its work with twelve universities, eleven research organizations and seventeen private firms under contract with the Federal government. Director of the OSW is C. F. MacGowan.

Making good water from bad is not a new problem for study. A Sanskrit manuscript, 2000 B. C., advises boiling water and then dipping it up and down in hot copper "seven times" before filtering it. Aristotle wrote of salt water which when evaporated and condensed, became sweet and did not return to its salty state. Sailors once boiled sea water in bronze vessels, catching the vapor in sponges.

Nearer our time, Thomas Jefferson described common experiments and devices for distillation. He showed particular interest in one referred to as "Captain Chapman's Simple Contrivance," and recommended all who were going to sea to be familiar with it. Some eighteenth-century sailing vessels utilized apparatus based on Benjamin Franklin's cooling-by-evaporation theory. Two centuries later, condensate from power boilers was used for potable water.

One of the first "modern" land-based installations was at Baku in Russia, 1898–99. It had a reported thermal distillation output of 279,000 gallons a day. Thirty years ago the Dutch made a similar installation of improved design on wind-blown Curacao in the Netherlands West Indies. It is still in operation, though augmented through the years. Outflow is so pure it is tasteless. Flavor is added by filtering it through beds of chipped coral rock.

Of the more than 30 conversion processes today, only a few are considered really feasible. None is actually economically practical for general use. Costs—capital investment, fuel availability, maintenance and operating expenses—vary widely from method to method, from installation to installation. The OSW believes that any large-scale process that may approach a maximum cost of 50 cents per 1000 gallons per day output is worth developing.

Saline Water Conversion

REMOVING WATER FROM SALT

Thermal Distillation

SALINE water conversion processes can be divided into two basic classes: those which involve methods of taking water from the salts; and those that take the salts out of the water. This report will discuss only the former: the many variations of thermal distillation; as well as extraction and adsorption, freezing, and gas hydrate chemical processing. (The second class, at present more commonly applied to brackish water than sea water, deals with electrodialysis, osmionic processes and reverse osmosis.)

No single method is likely to be universally used. One reason is the variation of salinity in water to be treated. Oceans average 35,000 ppm. In the Persian Gulf, though, they reach nearly 40,000 ppm. In the Baltic Sea, the count drops to 7000 ppm; Great Salt Lake, a high of 250,000 ppm.

Another factor working against a universal method is energy required, which varies from process to process. The absolute minimum to separate 1000 gallons of fresh water from sea water is 2.8 kwh, regardless of the conversion process used. But this thermodynamic minimum is ideal. In practice, the energy is usually fifty times greater. One aim in current processes is to reduce this minimum to 10 to 15 kwh per 1000 gallons of output.

Still another factor that results in making one system more practical than another depending on local conditions is the nature of the intake water and the purity required for use of outflowing fresh water. The U. S. Public Health Service says drinking water should have no more than 1000 ppm of dissolved salts, and preferably less than 500. For agriculture in most instances, the maximum allowable is 1200 ppm. Some industrial cooling water can be sea water, but in high-pressure boilers, almost pure water is necessary, with no more than 2 or 3 ppm.

The oldest and most popular method of removing water from salt—popular in research activity as well as in pilot and demonstration plants and commercial installations—is thermal distillation. It accounts for about 90 percent of present annual equipment markets of about $40 million. Within this broad category are a variety of systems that differ considerably in temperatures and pressures required, equipment, and fuel used. Coal, petroleum and natural gas are conventional. Solar energy and ocean temperature differences are receiving considerable study for reasons of economy.

Basically, distillation processes have two distinct steps: formation of water vapor from sea water; and, condensation of vapor to pure water. Residual brine is discharged as a by-product. (It should be noted that this does not add to water pollution, except perhaps at some inland installations. Furthermore, taking saline water from the oceans and converting it does not lessen the basic natural water supply. It increases it.) The variations of this basic process are usually identified by the method used to transfer energy to the sea water. Their development has resulted from searches for improvement of thermal efficiences and reduction of scaling.

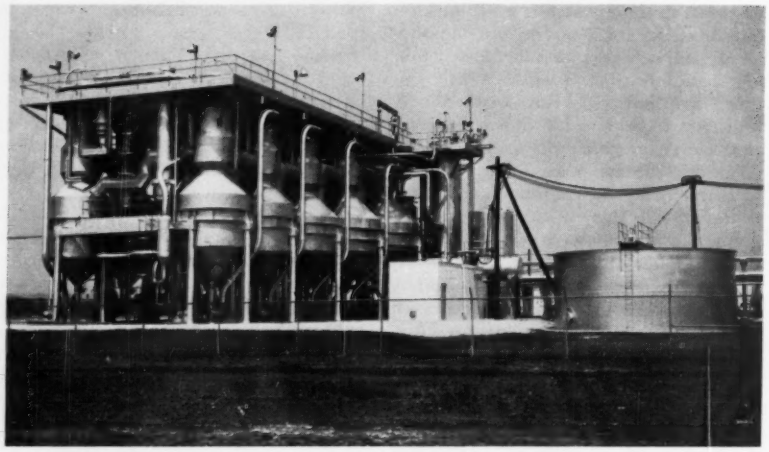
Brackish—Slightly Saline	**1000– 3000 ppm dissolved solids**
Brackish—Moderately Saline	**3000–10,000 ppm**
Brackish—Very Saline	**10,000–35,000 ppm**
Sea Water	**35,000 ppm**
Brine	**35,000–plus ppm**

Multiple-Effect Distillation

In single-stage distillation, water is evaporated and condensed in one step. In multiple-effect (-stage) distillation, latent heat of vaporization is reused. The amount of water distilled in each effect is approximately the same, but the heat consumption for a given amount of water is just about inversely proportional to the number of effects used. For the given amount of water outflow, then, it may be said the cost of equipment is greater than with single-effect

systems. Capital and fixed charges are increased, too. But, fuel costs are lowered.

Here is how a multiple-effect system works. Sea water is evaporated to steam in the first stage. Pressure in the chamber is either atmospheric or slightly higher. The steam passes from the first stage to coils in the second evaporator. There it condenses under slightly lower pressure. Condensate is collected as distilled water. During condensation, the steam releases latent heat which is used to evaporate sea water in the second container. So the process goes, through each successive effect. Vacuum pumps keep each evaporator under a lower pressure than the preceding one. The number of effects that are practical depends on fuel and equipment costs.



DEMONSTRATION PLANT **This 12-effect, 1,000,000-gallon-per-day plant at Freeport, Tex., went on stream in June 1961. Operating temperature ranges from 250° F in the first stage to 120° F in the last effect. Intake water has a salinity of 35,000 ppm; the product water, 50 ppm dissolved solids.**

Long-Tube Vertical

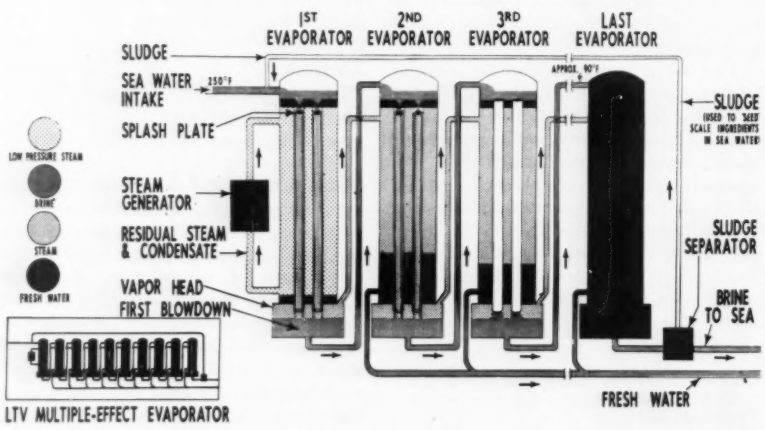
The long-tube vertical (LTV) evaporator is a refinement of the multiple-effect system. Several tubes are located in a nest. The heating system is outside and the liquor inside. Feed brine enters the bottom. As it flows upward, it starts to boil. Evaporation of vapor causes a large increase in volume and gives a very high velocity to the mixture. Consequently the heat transfer co-efficients obtained are quite good.

In the larger sizes, this is the least expensive type of tubular evaporator currently available. Its major drawback is scale formation. Seeding the feed water with magnesium hydroxide or calcium carbonate is one method now under study for combatting this. This seeding process opens the possibility of utilizing mild steel in much of the plant. Acidification or pH control is also used.

An LTV evaporator has been operating 3 years in a pilot installation at Wrightsville Beach, N. C. Specifically under examination are several construction materials such as mild steel, cupronickel and aluminum brass. As a result of data gained, a 12-effect LTV evaporator to produce 1 million gallons of distilled water daily was constructed at Freeport, Tex. It went into full operation in June of this year as the first of five saline water conversion demonstration plants authorized by Congress through the Office of Saline Water.

Submerged-Tube Evaporators

Multiple-effect, submerged-tube evaporators reverse the positions of the heating and liquor elements in the LTV units. Steam coils in an evaporator shell are covered by sea water. When heated, vapor is given off. The vapor is used to heat salt water in the second effect, and so forth in succession. It is ideal where requirement for both water distillation and electric power exist. It is impractical beyond several effects because of heat losses.



LONG-TUBE VERTICAL PROCESS

Vapor Flash Distillation

Another major variation is vapor flash distillation. Of the dozen or so land-based plants installed during the past 24 months, the emphasis has been on multiple-effect flash evaporators. It is a basically simple operation that makes use of low-grade, poor-quality steam—steam that has usually done other work previously, as, say, in power generating plants. Heat sources for vapor flash units might include turbine exhaust, gas turbines, separately fired boilers and nuclear steam generators.

Water under pressure and at about 180° F is sprayed into a chamber of lower pressure and temperature. A portion flashes into a near-pure water vapor, is condensed and piped off. Remaining salty water, somewhat cooler and more concentrated, passes through a series of additional chambers where the process is repeated, deaerated makeup water being added and pure condensate being piped off in each successive effect. (Deaeration of the makeup decreases the corrosive effect of the brine, enabling use of carbon steel shells in the unit.) Each succeeding chamber operates under a slightly higher vacuum than the one preceding it. Multistaging is used to increase the ratio of distillate produced to steam supplied. The process operates under low pressure differentials. Its economy is closely related to the effective design of the heat exchange system.

This method is used on aircraft carriers, destroyers and merchant ships. There are also a number of large land-based installations, notably one at Kuwait on the Persian Gulf which has been in operation since late 1957. Many stages can be used because in this type of process, the performance ratio (the pounds of water per 1000 Btu) does not

vary directly with the stages as in a multiple-effect system. A 36-stage unit to produce 1 million gallons a day is under construction at Point Loma, San Diego, Calif. It is another of the five demonstration plants authorized through the OSW. Fuel will be residual oil in a conventional packaged boiler.

Besides furnishing drinking water, flash units can be effectively applied for boiler feed makeup in central stations and industrial plants. Normally a single-stage unit, in the first situation, taking steam from the low-pressure feed water heaters, is suitable. In industrial plant applications where large quantities of makeup are needed for processing, both single and multiple stage units are used. These can be operated at virtually no thermal penalty to the turbine heat rate. One manufacturer reports its current designs produce vapor with impurities of less than 0.05 ppm of solids when fresh water is used, and 0.25 ppm when salt water is the source.

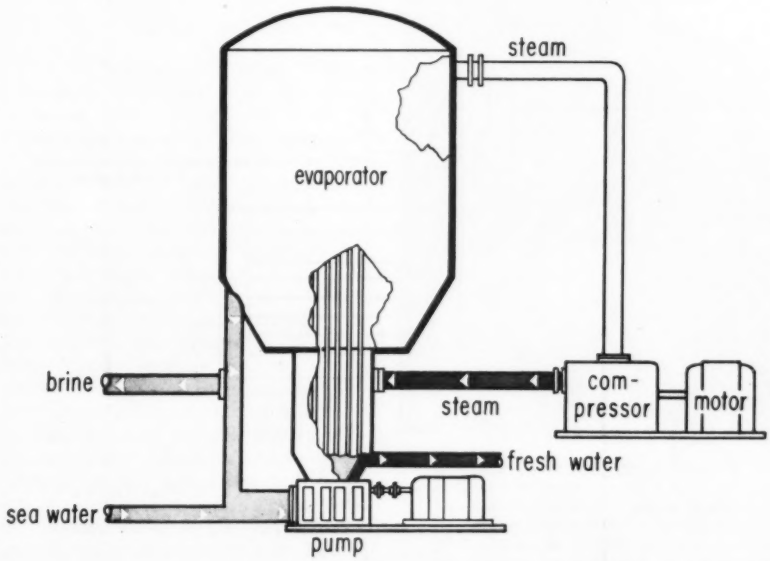
Vapor Compression

In vapor compression, salt water is passed through a heat exchanger into an evaporator. The vapor produced there is further heated by compression and reintroduced into the heating system to supply heat for boiling the solution. Energy required for evaporation is therefore supplied to a vapor compressor; condensate and residual brine are cooled by heat exchanges. Since operation at high temperatures is more advantageous, temperature differences across the heat transfer surface should be kept at a minimum to conserve power requirements. If temperature differences exceed 10° F, the power requirement is so large the method is not as attractive as the regular thermal distillation systems.

Probably the first compression distillation patent was granted to Pierre Pelleton of France in 1840, but because of engineering difficulties, the process was discouraging to early inventors. Attempts were made to use jet compressors in 1856, and this met with some success. A quarter of a century later, Jules Weibel of Geneva obtained a patent involving the utilization of a reciprocating compressor. The earliest American to enter the field was Addison G. Waterhouse to whom a patent was issued in 1897.

Only after the First World War did noteworthy progress begin, and that in Europe. Little was done in the U. S. until Robert V. Kleinschmidt and Allen Latham of Arthur D. Little, Inc., began successful experimentation. Their initial work led to thousands of small vapor compression evaporators (see *Compressed Air Magazine*, May 1946) on ships and isolated islands during World War II. Following the same tradition, today's Polaris submarines utilize 2000-gallon-per-day vapor compression units (in addition to steam multiple-effect types), but these are of special noiseless design.

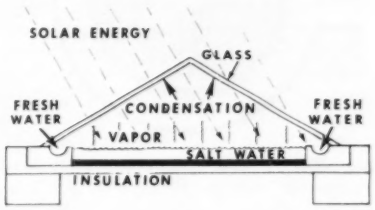
One variation of the system under development uses forced circulation of brine within tubes. The compressed steam condenses in droplets, rather than as a thin film on the outside of the tubes. Yet another variety uses a rotating drum. Rotation causes sea water to spread into a thin turbulent film and the condensate to be constantly thrown off. This promotes high heat transfer rates, even at low operating pressures and temperatures. Consequently scale formation is considerably lessened.



VAPOR COMPRESSION, FORCED CIRCULATION

Solar Distillation

Solar distillation was used by primitive man, though he was trying to obtain salt, not fresh water. In 1872, the first commercial attempt to obtain fresh water was made in Las Salinas, Chile, for water for mine mules. The glass-roofed still covering 51,200 square feet, remained in operation until 1902. It then became more economical to import fresh water by a narrow-gauge railroad.



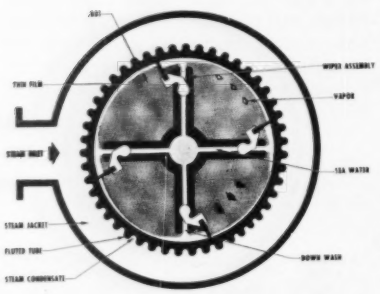
Generally a solar still has one or two glass inclined roofs, of the greenhouse type. These are the heat exchangers. They admit about 90 percent of solar radiation at normal incidence, and also act as (air-cooled) condensing surfaces for vapor coming from the brine. Beneath them is a blackened pan, or boiler, which holds the saline water. At the bottom edges of the covers are troughs for collecting condensate which runs down the underside of the glass. Theoretical capacity is about 1.9 pounds per square foot per day for a radiation of about 2000 Btu per square foot per day. The energy available, however, is dependent on latitude. At about 30 degrees latitude, sunlight will evaporate 1 pound of water per day per square foot of surface.

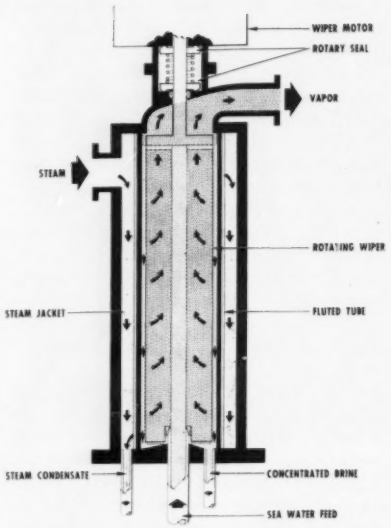
Although the heat source is often considered free, a cost problem does arise in capital investment. Solar distillation at present is not economically competitive except where fuels are scarce.

Critical Pressure Distillation

Critical pressure distillation is another means of reducing the cost of distilling water. Latent heat of vaporization is reduced by distilling water under high pressure—3200 psia. When the salt solution is heated to about the critical temperature, the solution changes from liquid to vapor with very small additional energy and correspondingly small loss in heat transfer. It then vaporizes, the vapor and concentrated brine flowing countercurrent to preheat the incoming solution. Heat in the process is sensible heat rather than latent, thus most of it is recovered by the countercurrent heat exchanger. The greatest

THIN-FILM UNIT Shown below is General-Electric Company's distillation unit and wiper assembly cross-section. At right is a schematic showing the operation of the salt water conversion system.





problem in this system is scaling and corrosion.

Thin-Film Distillation

General Electric Company has been conducting successful research on a thin-film water distillation process for municipal applications. Recent tests for the OSW show a significant increase in the heat transfer capability. Previous tests conducted by General Electric demonstrated the value of the concept for marine applications where restrictions of size and weight are critical.

The evaporator consists of a special vertical heat transfer tube, inside an outer shell. Sea water is fed into an internal wiper assembly where slowly revolving blades, operating similarly to automobile windshield wipers, spread the salt water on the inner surface of the inside tube in a film scarcely 1/1000-inch thick. Heat produced by steam passing over the outside fluted surface of the tube is transfered through the walls of the inside tube, causing the salt water to evaporate. Pure water leaves the evaporating chamber as vapor, and the concentrated brine is drained off.

Boiling of the salt water, which could seriously diminish purity, has been eliminated because the films of water are so thin they will not support bubble formation. The bubble-free distillation produces fresh water at a high purity by avoiding carry-over of mineral particles. The system presently under development can extract 42 pounds of fresh water from each 100 pounds of sea water.

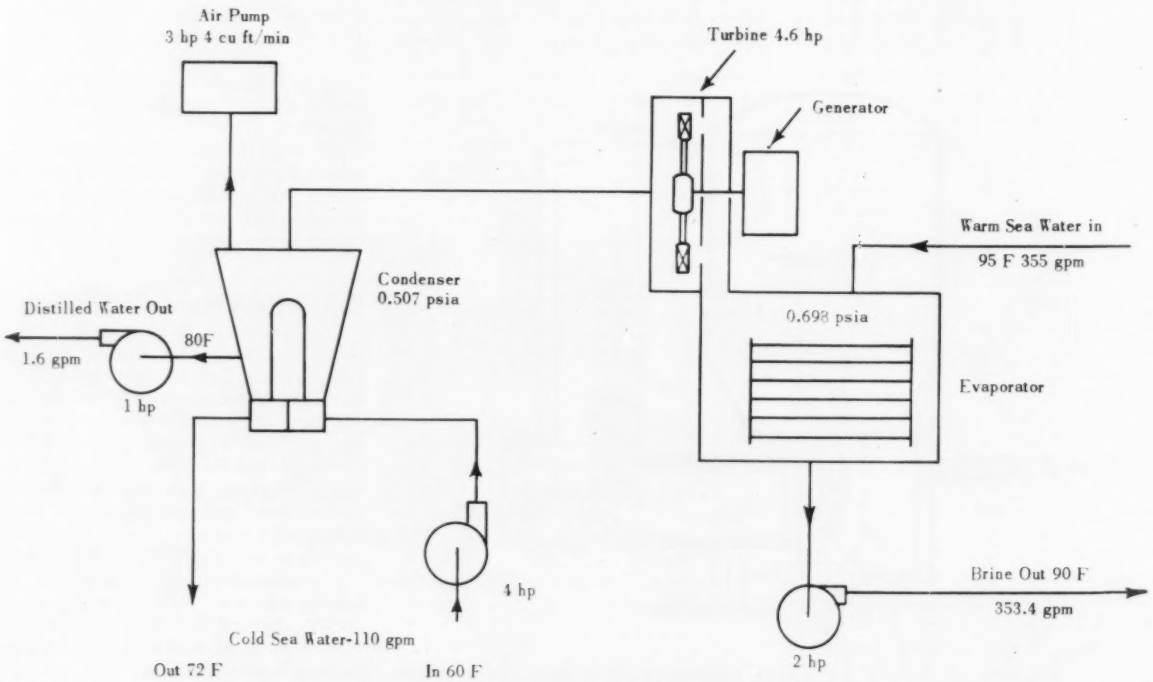
Ocean Temperature Differences

Using ocean temperature differences in thermal distillation was first proposed in 1928. This system is most suitable in tropical oceans where depths of $^1/_4$ to $^1/_2$ mile are reasonably accessible to land. Cold deep sea water would be pumped by suction through large-size pipes and used to condense vapor of warm surface water evaporated under vacuum. With a 30-degree temperature difference, about 60,000 gallons of cold deep sea water and 60,000 gallons of warm water from the surface would be required for every 1000 gallons of condensate produced. Pumping costs and high cost of installation make this system as expensive as those using solar energy.

Some other methods of taking the water from the salts will be discussed next month in this series, to be concluded with the outlook for saline water conversion.

(To be continued)

TEMPERATURE-DIFFERENCE This schematic shows temperatures and rates being used in an experimental plant at the University of California. Use of ocean temperature differences was first proposed by Georges Claude in about 1928. Successful tests were made in Cuba.



this & that

Battle Of The Gauges

Behind the lines in the great War Between the States, a wholly separate and singular conflict was waged on the railroads. This is referred to as the battle of the gauges. Up to 100 years ago, railroads in America were expanded with little regard for a uniform track gauge—the inside distance between the rails. The number of gauges had so mutiplied by 1861 that more than a dozen were in use, varying from 2 feet to the 6-foot Broad Gauge Route between New York City and St. Louis, Mo. The Association of American Railroads reports that the battle finally came to a head in 1862 under the impact of war demands. President Lincoln was asked to determine a standard gauge for the transcontinental line then proposed. He resolved the issue in the face of bitter rivalry by proclaiming on January 21, 1863, that the California standard of 5 feet would be used. Congress, however, promptly rejected Lincoln's ruling in favor of the British standard of 4 feet $8^1/_2$ inches. This, then, became the determining factor in establishing the prevailing gauge in America.

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Firefly's Secret Unlocked

Chemists at Johns Hopkins University have reproduced the glow of the firefly by combining five chemicals. The insect's light has long been a mystery to scientists and though the light source probably won't be used by man, knowing about it is another step in understanding nature. The study was begun about 15 years ago by Dr. William D. McElroy who bought fireflies from Maryland youngsters for 25¢ a 100. He needed as many as 800,000 every summer since the chemicals occur in such tiny quantities. The five substances were first singled out in 1952 as being oxygen, certain magnesium salts, adenosine triphosphate (ATP), and two new compounds. One was named luciferon (light giver) and the other, luciferase, an enzyme that enables luciferon to act. A team headed by Dr. Emil H. White at the University began analysis of luciferon about 3 years ago. Last year the compound was synthesized in the laboratory. Dr. White now reports that he is able to make up to 1 gram of the material, or about the same amount flashed by 2,000,000 "lightning bugs."

★ ★ ★

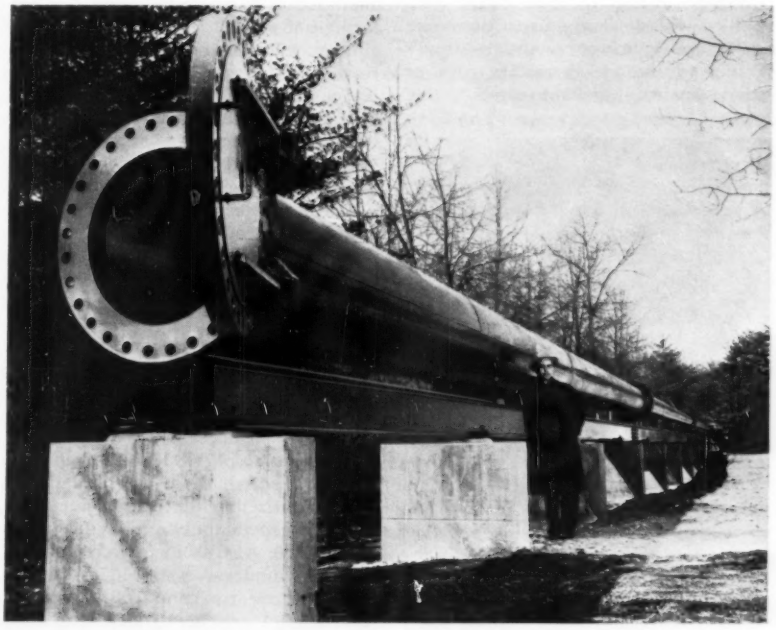
Money On A Spool

The Manufacturers Trust Company in New York has started keeping its "money" (evidence of payments through the bank) on magnetic tape. Its new data center will soon begin handling 467,000 regular and special checking accounts as well as sorting some 100 million checks a year that depositers write. Storing money on magnetic tape is the most recent step in the physical evolution of lucre. From the coins of Roman times, money about 200 years ago began switching largely to paper bills. More recently checks have come to make up 90 per cent of the total money supply.

★ ★ ★

Natural Satellites Reported

A Polish astronomer reports that he has photographed two cloudy objects circling the earth in an orbit the same distance away as the moon. If confirmed by other astronomers, the discovery would mean the location of earth's first natural satellites other than the moon. Little information is available but it appears that objects are not solid bodies but swarms of meteoric material trapped in a zone of low earth-moon gravitational pull. The pocket where the material is held is 60 degrees ahead of the moon in its orbit. It is equidistant from the earth and moon, about a quarter of a million miles away. Another such gravity-weak area trails the moon by 60 degrees in the same orientation. Dr. K. Kordylewski, the Cracow University astronomer who told two American astronomers of his finds, probably will look for satellites in this following pocket in January 1962.



SIMULATED NUCLEAR BLASTS The 180-foot tube shown above is a scale model designed to help the U. S. Naval Ordnance Laboratory build a bigger one. If a 5-pound charge is fired at the small end of the tube, the blast is amplified 25,000 times as the shockwave expands along the confines of the pipe. The model will predict the performance of a 2000-foot-long shocktube in which a blast wave from a 1000-pound charge can be amplified to correspond to a nuclear explosion of many kilotons. Standing beside the blast simulator is William S. Fuller, the physicist who conceived and developed it.

The two Americans have termed the satellites as "interesting" but point out that they probably would not be officially recognized because they are insignificant in comparison with celestial bodies in general.

An American astronomer looked for natural minor satellites of the earth from 1953 to 1958 but didn't find any. He scanned areas where they "ought" to be—that is where he believed they would naturally occur. This suggests that the Polish scientist's discovery is a case of "astronomer's luck." The U. S. astronomer is Dr. Clyde W. Tombaugh who discovered the planet Pluto in 1930 and who is now at the New Mexico State University's research center. The satellite discoveries were reported in the *New York Times* by way of a circular of the International Astronomical Union and the July issue of *Sky and Telescope*.

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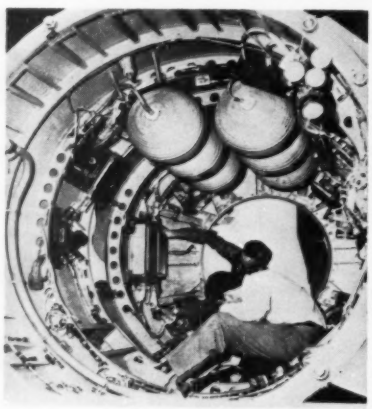
Flying Fiber Glass

The picture gives you a view into the tail section of a Redstone booster rocket, the type used in NASA's first manned suborbital launchings. The two men are completing installation of lines from the six filament-wound fiber glass pressure bottles visible in the top part of the photo. Designed and produced by Apex Reinforced Fiber-glass, Cleveland, Ohio, the vessels point up the utility of fiber glass as a space material. The bottles will be filled with 3000-psig air to pressurize fuel tanks, assuring a constant supply of fuel to the rocket motors, and to actuate main propellant valves. The



units are about 15 inches in diameter and contain about 1700 cubic inches of air. In the Mercury capsule itself two 8-inch-diameter Apex Fibre-glass units are employed. Eighteen small (1 to 24 pounds thrust) rocket motors control attitudes of the capsule. The smaller bottles, pressurized with 2200-psig nitrogen, force hydrogen peroxide fuel into the control motors. One vessel is linked to the 12 motors in the automatic system and the other is part of the 6-motor manual system. Fiber glass vessels were selected because of their good strength-to-weight ratio, off-the-shelf availability and because they previously had been thoroughly engineered and tested.

★ ★ ★

Isotope Of Element 103 Discovered

Scientists at the Lawrence Radiation Laboratory, Berkeley, Calif., recently discovered the isotope of element 103. First evidence of the element was found in February and the following 2 months were spent in confirming the results. In all, about 3 years were devoted to "creating" the element, the first to be discovered solely by nuclear methods with no help from chemical techniques. The scientists performed their experiments with a heavy-ion linear accelerator. They bombarded a target consisting of three millionths of a gram of Californium, (element 98) with boron 10 or boron 11 nuclei having energies of about 70,000,000 electron v. The new element has no practical application at the moment but broadens the fundamental understanding of matter. According to one theory, it is a "dinosaur" of matter which was formed at the birth of the universe but decayed out of existence in a matter of weeks. The element has a half-life—the time it takes for half of a given amount to decay into another element—of about 8 seconds. Its discoverers suggest that it be named lawrencium in honor of the late Ernest O. Lawrence, the Nobel prize winner who invented the cyclotron and founded the Laboratory bearing his name. The discovery of element 103 was the work of nuclear scientists Albert Ghiorso, Torbjorn Sikkeland, Almon E. Larsh and Robert M. Latimer.

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Fallout Research Booklet

The Atomic Energy Commission has published the fourth pamphlet in a series describing its life sciences research program. Entitled Atmospheric Radioactivity and Fallout Research, the booklet is designed to familiarize the scientific community and the general public with the objectives of the AEC's biomedical program. Work is underway at 36 institutions under 40 research contracts or projects. The studies can be divided into four broad areas: 1. determination of the concentration and characteristics of radioactive fallout and other trace materials in the atmosphere; 2. theory and observation of the nature of atmospheric motions which transport, mix and deposit radioactive contaminants and tracers; 3. influences of conditions, such as height of burst, at the time of nuclear detonations on the characteristics of resulting fallout; and 4. relationship of diet, fallout rate and accumulated fallout to radioactivity in soil, food and man. The booklet may be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington 25, DC at 75¢ per copy. Others in the series are Marine Sciences Research (TID-4040), 50¢; Genetics Research (TID-4041), $1.25; and Cancer Research (TID-11132), $2.25.

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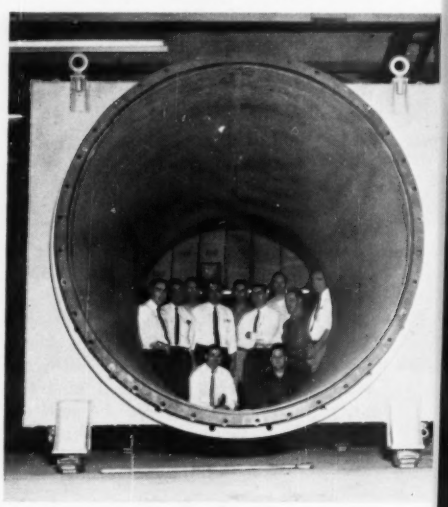
Largest Magnetic Flowmeter

A 7-ton giant magnetic flowmeter is pictured with the staff of Fischer & Porter Company engineers that designed it. Built for use at the Seadrift, Tex., plant of the Union Carbide Chemicals Company,



the meter will measure the quantity of water being pumped from the plant's cooling water basins. The figures will be used for cost accounting purposes. The measuring instrument is $7\frac{1}{2}$ feet high, $16\frac{1}{2}$ feet long and $8\frac{3}{4}$ feet wide, and is described as being the largest ever manufactured. Having a maximum flow capacity of 450,000 gpm, the unit determines flow magnetically outside the pipe and avoids using any internal obstructions. In effect the meter is a simple a-c generator with the liquid acting as the conductor passing through the magnetic field which surrounds the pipe. A voltage is created at a pair of electrodes (analogous to generator brushes) and this current is directly proportional to the volume rate of flow. The voltage is transmitted to standard recording instruments located several hundred yards from the meter. The flow monitoring tube is stainless steel lined with neoprene.

editorial

Vacuum

ORIGINALLY vacuum meant an empty space, one completely devoid of matter. Even laymen, thanks to popularization of space age projects, now recognize that the perfect vacuum of theory just doesn't exist. But not often recognized are the growing applications of the condition called vacuum.

It was in 1654 that Otto von Guericke made his classic experiment with copper hemispheres at Magdeburg, Germany. It took 250 years before a practical application was made of his nothingness experiments, and almost another century and a half before many of the potentials of vacuum were realized. In 1803, Richard Trevithick, of steam locomotive fame, utilized the first steam-jet ejector to draw a vacuum on a firebox thereby improving the draught. The idea was a good one—it persisted almost unchanged until the steam locomotive was replaced by diesels.

Today vacuum is one of industry's most important process tools, yet one not always understood for what it is. The trouble probably stems from the original definition and the difficulty of assigning degrees to nothingness. Vacuum is a lot easier to deal with in words if it is referred to in terms of absolute pressure. Degrees of vacuum are then expressed in pounds per square inch and microns, millimeters or inches of mercury or water pressure—absolute terms not so subject to misinterpretation.

The miles-thick blanket of air that surrounds the earth exerts roughly 15 psia uniformly over its surface. The pressure is an important part of our environment, to be sure, however it smothers a lot of events that otherwise would take place, giving rise to one major use of vacuum. Such a concept as molecular distillation was but a curiosity and tool of the laboratory before World War II. It now is commercially used in petroleum refining and chemical synthesis processes. It's much the same as fractional distillation, but at low absolute pressures, so that low-violatile substances can be derived.

Something akin to this has to do with the vaporization and deposition of metals on any of a variety of other materials. One commercial application is the coating of optical lenses, a process calling for extremely low absolute pressures.

An important part of food and pharmaceutical manufacture is the technique of freeze drying. Many frozen solutions will sublimate at low absolute pressure—the water in them will go directly from the solid to the gaseous state without first liquefying. This makes possible the drying, dehydration or thickening of many sensitive compounds, from blood to penicillin and vitamins, that ordinarily would be damaged or spoiled by drying. Where freeze drying isn't needed, vacuum still helps. In making condensed milk for example, the pressure is lowered so that excess water will boil away at a temperature that won't harm the flavor or composition of the milk.

The oxygen in the air blanket is another factor that gives rise to vacuum uses. Highly reactive, oxygen is better done without in many reactions and in many storage jobs. Vacuum packing preserves food because it protects it from oxygen that many bacteria must have to live. Flavor can be destroyed by oxidation too, thus coffee is vacuum packed to protect its fragrant oils.

Metals made by air melt techniques have inclusions of all kinds of gases and some oxides. A lowering of pressure over the ladle results in the disappearance of many gaseous inclusions and vacuum refining techniques can take out the oxides by removing the surplus of oxygen that permits them to form .

Electric lights "burn" longer today because they don't burn. That semantic twister is based on a strict definition of *burn*—to be oxidized. Thus a heated filament will glow for a long time only if there is no oxygen present to consume it. There has been a significant increase in lamp longevity in recent years; the improvement in techniques for obtaining low pressures is largely responsible.

Although electronic tubes and electric lamps are thought of in the same breath, there is a subtle difference in the necessity for evacuation. Besides inhibiting oxidation or burning of heater plates, electronic tubes are evacuated to prevent interference with electron streams. Similar reasons stand behind the spreading use of very low absolute pressures in the atomic energy research fields. Physicists can't tolerate extraneous influences acting on the tiny bits of matter and energy they now deal with, so they try by every possible means to eliminate the atmosphere. Cyclotrons, bevatrons and bubble chambers, among other atomic research tools, are all evacuated to very low absolute pressure.

The pressure exerted by the surrounding blanket of air isn't always a hindrance, of course. It makes pumps prime for most low head applications, and has a couple of other advantages that vacuum techniques make use of, techniques that go back to the Magdeburg hemispheres. Vacuum lifts are indeed no more than Magdeburg spheres and are used to handle plate glass, sheet metal, television picture tubes, paper sheets and the like.

Papermaking is another process that relies heavily on vacuum. In flat boxes, under the Fourdrinier screen, vacuum is applied to draw water away from the almost fluid pulp sheet. Two actions are present in this operation: the overlying blanket of air presses the paper to the screen squeezing out water, and the air flow initiated by the vacuum pump helps to carry it away. On couch rolls and presses, vacuum is applied to remove excess water, too.

The increasing use of low absolute pressure techniques has been largely due to the availability of machines that can efficiently and economically produce and maintain vacuums of all degrees. Vacuum melting and refining of metals is one example—the volumes evacuated, and the gas flows handled for these processes are so great that there was some question only a few years ago that they would ever be justified from an economic standpoint. Another case in point is a centralized vacuum system, described in this issue, that makes vacuum a less expensive commodity in paper mills. These two examples, coupled with many others, add up to the fact that vacuum equipment makers are doing a good job from two standpoints. Not only is equipment being built to stay even with, or even ahead of, new demands, but old processes are constantly being reviewed to see if vacuum equipment can't be made more efficient, more reliable and more economical.

A RESTAURANT SUSPENDED IN THE AIR

AFTER 3 years of construction, the new city-owned jet airport, 10 miles from downtown Los Angeles, Calif., is in operation. It can handle one of the largest air traffic volumes in the world, about the same, in fact, as New York's Idlewild, although it covers about a third the area (Idlewild, 655 acres). Idlewild's facilities fan about a great circle; the Los Angeles terminal, a mile west of Los Angeles International, is composed of seven satellite terminals extending from each side of a rectangular central mall, consisting principally of a 52-acre parking lot.

Undoubtedly the most dominant feature is the Theme Structure—a tower-like building thirteen stories high and seemingly suspended from intersecting parabolic arches. They span 340 feet and rise 135 feet. It contains a 300-seat, glass-walled gourmet restaurant floating 70 feet in the air. The Theme Structure cost $2,200,000 of the total project's $50,000,000.

The central core of the building is reinforced concrete, 30 feet in diameter and rising about 85 feet. It is designed to resist lateral loads, and rests on a 66-foot-diameter, 6-foot-deep concrete disc. Contained in the core are one freight and three high-speed passenger elevators to service the restaurant and observation deck. In addition to the sky-high restaurant, with its world landmarks motif, and the observation deck, the structure also has a low, circular ground-level unit containing an employee cafeteria, bank, barber shop, gift shop and central commissary for the other restaurants in the new terminal area—one in each of the satellite buildings.

Approximately 900 tons of structural steel was required for the building. Fabrication and erection were under a Kaiser Steel contract. Rolling of the steel began in March 1960 and was completed by the end of June the same year. Fabricated sections included four 105-foot-long upper arch sections, each weighing 10 tons; four lower arch sections, 39 tons each, 107 feet long; four horizontal legs, 38 tons each and 38 feet long; and a tension and compression ring 6 feet high and weighing approximately 33 tons.

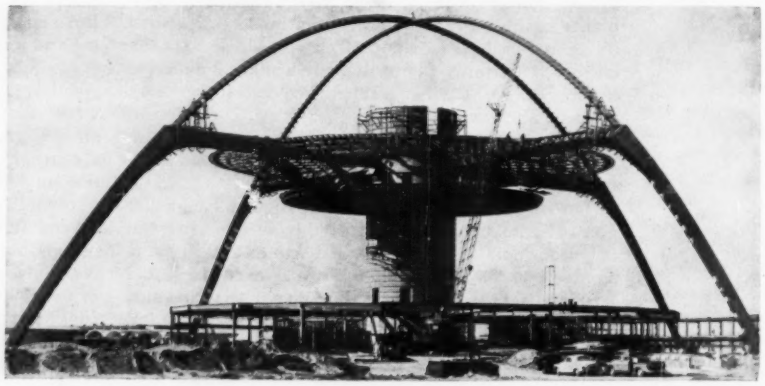
All steel sections were shipped to the job site by truck. In the case of the arches, dollies were used with the arch forming the body of the truck. Due to the size of the steel units, sections were trucked during light traffic hours.

An unusual amount of steel false work was constructed prior to erection of the steel. Three temporary 80-foot towers were built to support the arches; each tower was equivalent in height to an 8-story building. The tension and compression ring was erected August 2, last year. It is placed on the central column 70 feet above the ground, and supports the restaurant and observation deck by means of steel girders cantilevered radially from the ring. They taper from 6 to 2 feet in depth. Two large cranes, one 50-ton and one 80-ton, were required for this job.

Installation of completed arch sections was finished last December. The lower arches were first welded to the horizontal legs, which were attached to the central core. Then the upper, slimmer, arches were welded to the lower sections and a top weldment. This is the first time supporting steel arches of this design have been used.

All concrete and steel was sprayed with a near-white vinyl plastic coating, 40 mils thick, to cover surface imperfections—weld joints, form marks and the like. This also makes the structure waterproof and should require no maintenance for 8 to 10 years.

Architects and engineers for the Los Angeles International Jet Age Terminal are Charles Luckman Associates, coordinating architects; and Welton Becket & Associates, and Paul R. Williams & Associates. Builder for the Theme Structure as well as the terminal area, ticketing and satellite structures is Robert E. McKee General Contractor, Inc.



Industrial Notes

TO AID industry in properly applying air power and control, an educational exhibit of fundamental pneumatics techniques is touring the U. S. under the sponsorship of Ross Operating Valve Company. The mobile "Air Control Technics" features six display panels of air circuitry. Each demonstrates two or three ways of attaining a specific objective. Its purpose is to spark industrial, technical society and school audiences to recognize applications of pneumatic circuitry to their own problems.

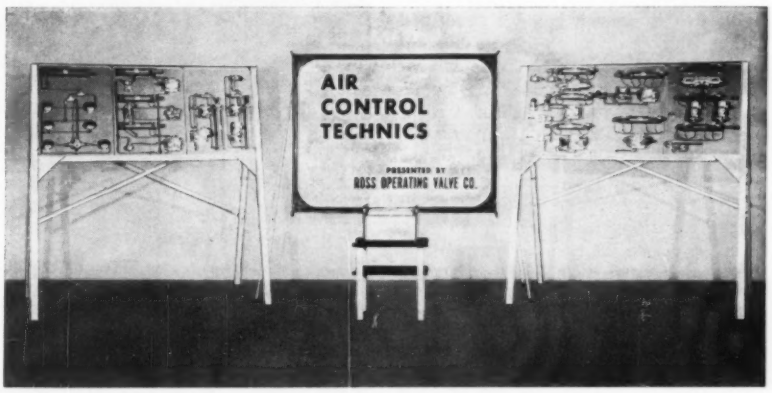
The 70-minute show opens with a commentary on properties of compressed air, phases of an air system, basic and auxiliary valves, valve functions and methods of operation. Slides illustrate each item discussed.

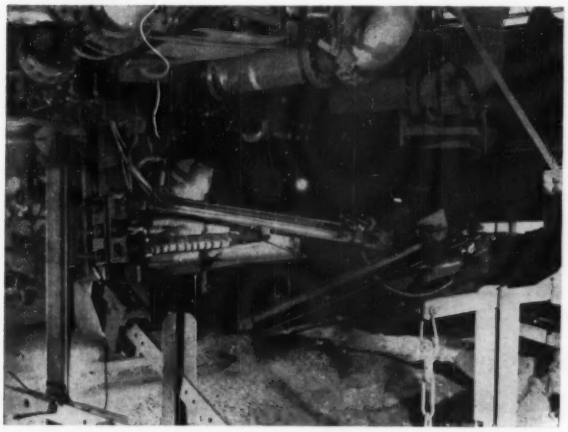
Then an engineer demonstrates the air circuitry units. Each of seventeen set-ups can function as a complete control circuit, or as a portion of a circuit. Six facets of air circuitry are shown:

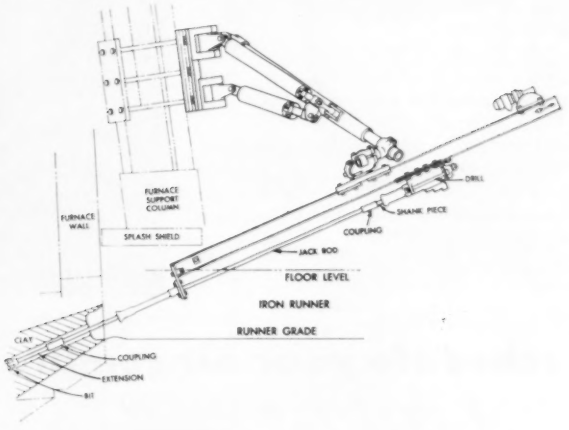
(1) *Two-hand operation keeps an operator's hands safely occupied during a machine cycle.* First demonstrated is a series method that permits the operator to tie down one of two manual valves and leave one hand free. Next is a parallel method which does the same thing, but with lowered efficiency in the circuit. Safest is the third demonstration —one called the non-tie-down method, compelling the worker to use both hands to actuate the circuit.

(2) *More complex circuits are used to control a double-acting cylinder.* First, immediate extension and retraction are initiated by a pilot valve. Then delayed extension and immediate retraction, and immediate extension and delayed retraction are achieved with timed-in and timed-out sequence valves, respectively.

(3) *To retain the highest possible ma-*







TAPPING JACK is the name of a new blast furnace tap drill offered by Ingersoll-Rand Company. It consists of an air-operated percussion drill on a flexible air-hydraulic mounting that permits one man to tap the furnace from a safely located control station. The hydraulically positioned drill boom accurately locates the tap hole and returns to the set position for successive casts without further adjustment. The unit is reported to be able to drill up to a $4^1/_2$-inch hole through the new hardened tap hole mixes for fast metal flow.

In the photograph at left, the Tapping Jack is mounted on a support column on the left-hand side of a large blast furnace. The boom and drill guide are shown in drilling position, aligned with the furnace tap hole. The unit is also available for pedestal mounting and for the right-hand side of the furnace. Details of the drill and boom are shown in the line drawing at the right. The boom is 8 feet long and can be extended to 12 feet.

The manufacturer claims that the air and hydraulic system allows infinite control of feed and retraction motor speed, drill speed, and blowing air for cooling the drill bit. A high-speed retraction motor withdraws the drill rod from the hole after the skull is penetrated. Air pressure is directed through the drilling rod during the drilling cycle to clean the hole of cuttings. It also keeps the bit cool. Explanatory bulletin, Form 4222, is available. *Ingersoll-Rand Company*, News Bureau, Phillipsburg, N. J.

chine cycling rate, yet control inertia and prevent damage to moving parts, deceleration is built into a circuit. First shown in this portion of the demonstration is a cylinder that can be extended rapidly for most of its stroke, then slowed to complete extension by air deceleration with a timed-in sequence valve. How to accomplish the same thing with an overriding-cam pilot valve instead of a sequence head is then illustrated. This is the more positive method.

(4) *Continuous reciprocation of a double-acting cylinder can serve as a machine timing device.* Here a mechanical method using two cam valves, a master unit with holding bleed and a manual pilot valve, is demonstrated. The hand valve is held open to maintain reciprocation. To accomplish the same objective, an electrical method is shown. In it, two limit switches are combined with a solenoid-operated main valve and air index adaptor. Electric current keeps the cylinder reciprocating. Finally, to achieve a dwell at each end of the cylinder stroke, timed-in and timed-out sequence valves are actuated with a manual pilot valve.

(5) *When a cylinder must dwell in extended position, delayed retraction can be accomplished by two methods,* according to the fifth part of the show. It can be accomplished by an all-air method with a manual pilot valve and a timed-out sequence valve. A time delay valve serves as interlock, assuring uniform dwell periods, regardless of how long the operator energizes the circuit. This can also be done by electrically timing a solenoid valve.

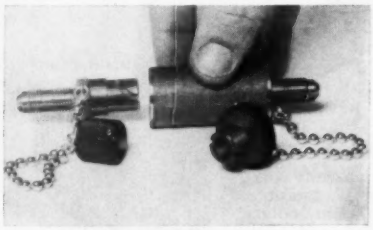
(6) *Finally shown is "inching control" or shuttling a cylinder back and forth and stopping it at any point in its stroke.* Three different valves are used.

After the lecture and demonstration, the audience may operate the exhibits and ask questions. Travelling in a station wagon, the streamlined display is adaptable to any meeting place where air pressure and 115-v current are available.

Information about the "Air Control Technics" itinerary, booking arrangements, and illustrated literature of the circuitry may be had from local Ross representatives or from the company's applications engineer, Don Gauthier, 120 E. Golden Gate Avenue, Detroit 3, Michigan.

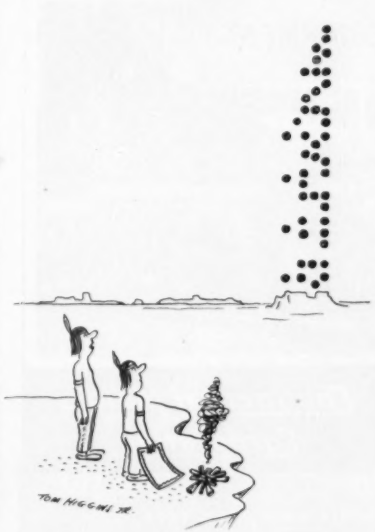
HANDLING 1.5 MMSCFD of natural gas at 60-psig pressure, the 2-stage scrubber, shown below—an Anderson Type L4-150 Hi-eF unit—was installed in a gas line to eliminate burner problems. (A baffle-type scrubber had failed to remove the liquid entrainment in a 4-inch feed line from a storage well serving stress-relieving and normalizing furnaces.) The unit, which is free from all moving parts, is removing 30 gallons of liquid entrainment per month. Customer complaints and burner problems are reported to have been eliminated. Literature is available about Anderson's complete line of scrubbers for liquid or dry separation. Interested persons may request Bulletin 601. *The V. D. Anderson Company,* a division of International Basic Economy Corporation, 1935 W. Ninety-Sixth Street, Cleveland 2, Ohio.

CRYOGENIC, pneumatic and hydraulic applications are for the miniaturized filled valve illustrated. The features of this device are leakproof design, a female portion weighing only 4 ounces, including its dust cover, and a male half that weighs only 2 ounces with cover. Operating pressure is 0 to 200 psig; operating temperature, —420° to 260° F. The ground (female) half incorporates an



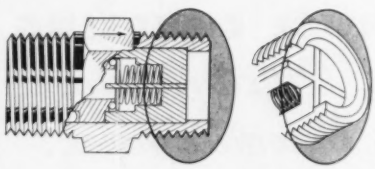
insulating sleeve and an annular air space as a thermal barrier. The valve can be supplied in a wide range of fittings. *Airborne Research & Development Corporation*, 7530 San Fernando Road, Sun Valley, Calif.

ULTIMATE in do-it-yourself-ing is a slide rule kit. Anyone can design and construct his own special-purpose slide rule for doing recurring calculations connected with his work. By using such a rule, a great deal of skill is unnecessary. All that is required is to align the various values with each other and read the answer. Since the scales are calibrated with the actual values they are to represent, it is not necessary to figure decimal point placement. Each of the kits contains the parts for making three basic slide rule blanks, and many variations, as well as a plastic scale plotting ruler, a universal logarithmic chart, and instructions. The blanks have one, two



or three slides and are constructed of drawing cardboard and plastic to provide a surface for plotting and inking scales. The material also gives the finished slide rule long-lasting usefulness, it is reported. Assembled slide rules are 3x11 inches. The special ruler and logarithmic chart simplify the calculating and plotting of scales. The illustrated booklet of instructions shows how to assemble different types of rule blanks from the parts included. It also explains the theory of slide rule design and gives step-by-step procedures on how to express almost any type problem or equation on a special-purpose slide rule. Cost, $8.50. *The Emil Greiner Company*, 20 N. Moore Street, New York 13, N. Y.

CHECK valves, designated as the 1500 Series, have been added to Bodnar & McDermott's line of valves. This is a disc-type unit and is housed in a standard hex nipple. Opening pressure is 2



psig, and because of open construction, the flow characteristics are reported excellent. Valves are stocked in brass. O-rings are of Buna-N and spring and disc are stainless steel. *Bodnar & McDermott Manufacturing Company, Inc.*, 19 Beechwood Avenue, Mount Vernon, N. Y.

FROM COLORADO comes a new catalog (No. 1000) detailing the complete Norgren line of pneumatic products. It contains 64 pages describing compressed air line filters, pressure regulators, air line lubricators, valves and miscella-

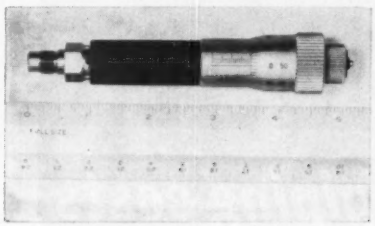
"You got the steam line going to the water cooler."

ney. In addition there is a section devoted to such useful engineering information as compressed air flow, moisture content of saturated compressed air, dimensional data, etc. Copies may be obtained directly from the company or from its representatives. *C. A. Norgren Company*, 3400 S. Elati Street, Englewood, Colo.

SPRINGS and spring-like things is a phrase that has nothing to do with the seasons. Rather it is a 16-page manual published by Associated Spring Corporation that gives engineers and purchasing executives authoritative information needed to specify custom-designed and standardized precision springs. The booklet summarizes basic information concerning helical springs, flat springs, wire forms, special fasteners, precision metal stampings, and assembled spring-like devices. It emphasizes designing for performance, accurate material selection, and quality control measures that will result in parts that meet the specifications of the user, thereby assuring performance reliability. The literature includes design briefs that simplify the specifying of compression, extension, torsion and flat springs, as well as wire forms. Case histories illustrate the advantages of early consultation with the springmaker on design of parts. As an added feature, mechanical properties and recommended uses of commonly used spring materials and cold-rolled spring steels are presented in tabular form. Copies are available without charge from the general offices of the corporation or through any of its operating divisions or sales offices. *Associated Spring Corporation*, Bristol, Conn.

DESCRIBING three self-contained driers, *Protect Your Pneumatic Controls Investment* is now available. Models covered are 101, 250 and 350, with capacities of 10, 25 and 35 cfm at 100-psig pressure. Technical information is given for each model and a piping layout is shown. Request Bulletin No. 610. *Zeks Industries, Inc.*, West Chester Pike & Providence Road, Edgemont, Pa.

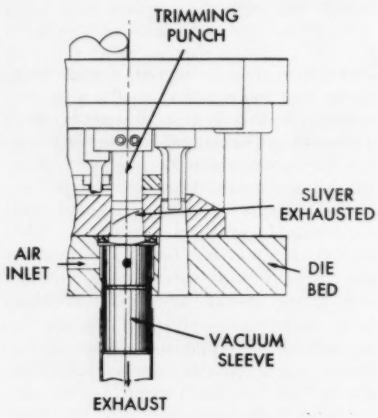
DESIGNED to accurately measure peak compression and combustion pressures in high-speed diesel engines, a mechanical indicator is offered by Kistler Instrument. Readings are displayed on a micrometer-type scale, graduated from 0 to 2000 psig in increments of two. Completely self-contained, the pocket-sized gauge consists of a differential piston and cylinder in which the measured pressure is opposed by a spring force. This varies with the setting of the micrometer thimble. The piston travel, about $^{1}/_{64}$ inch, is transmitted to a plunger projecting from the end of the micrometer thimble. Here the plunger motion is detected by



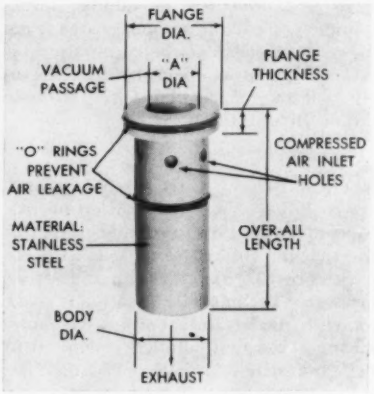
the user's finger. In operation, the indicator is set to a reading in excess of the peak pressure to be measured and inserted into adaptors previously installed in the engine. With the finger resting on the sensing plunger, the micrometer thimble is rotated in the direction of decreasing pressure. When the differential piston pulses the sensing plunger, it indicates that the peak pressure equals the setting of the gauge. The indicator is then removed, the reading noted, and the indicator is reset for the next reading. *Kistler Instrument Corporation*, 15 Webster Street, North Tonawanda, N. Y.

THIRTEEN Bazooka vacuum sleeves, which provide a vacuum source for re-

moving loose shavings, piercings, notchings or slugs from fabricated dies, are products of Air-Vac Engineering. With an "A" diameter (see diagram) large enough for scrap to pass through, they are designed to be installed into the die under a punch, as shown. A compressed



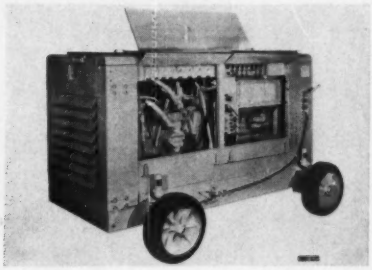
air inlet hole is drilled in the die so air is applied to the sleeve ports between the O-ring seals. This air then exhausts at the bottom of the sleeve, creating a vacuum in the die openings. To minimize air consumption, a pressure regulator or shut-off valve can be installed. (The company reports many successful jobs now running on 20- to 40-psig line pressure, giving a vacuum of 3 or 4



inches Hg.) Then, air can be supplied intermittently and adjusted to go on just before the punches hit the strip stock and shut off after they leave the die opening. Vacuum sleeves with "A" diameters of 0.109 to 0.750 inch are available immediately; models with "A" diameters of 0.937 and 1.250 inches are made on special order. *Air-Vac Engineering Company, Inc.*, 33 Old Stratford Road, Shelton, Conn.

AIR delivery of 80 cfm at 6000-psig pressure can be obtained from Ingersoll-Rand Company's 6-cylinder, 5-stage, high-

pressure compressor illustrated here. It runs at 1800 rpm, and can be purchased as a bare, base-plate-mounted, or portable unit. It is an air-cooled reciprocating compressor of radial design with all



the cylinders in a vertical plane. There is one throw on the crankshaft utilizing a master and articulated rod set construction. This provides maximum balance, minimum vibration and compactness. Easy maintenance is realized because each cylinder is individually cast and separately attached to the crankcase. A vane-type oil pump draws oil from the crankcase and completely lubricates all parts, according to a report from the manufacturer. All cooling is accomplished by a 26-inch-diameter, 6-blade steel fan mounted on the crankshaft opposite the drive end. Air is drawn over the compressor and forced over the inter- and aftercoolers. Intercoolers and aftercoolers incorporate moisture drain traps. Each radiator-type cooling section has its own separator and each is equipped with a woolen-packed insert for efficient removal of moisture and oil after each stage of compression. These high-pressure air, or gas, compressors have a wide range of applications: general support equipment for commercial and military aircraft and missiles; naval and maritime service; liquid oxygen plants; air starting of engines; test stands for valves and regulators; accumulator service; and the like. *Ingersoll-Rand Company*, Compressor Engineering Department, 11 Broadway, New York 4, N. Y.

Books . . .

Engineering Fundamentals for Professional Engineers' Examinations (published by McGraw-Hill Book Company, 327 W. Forty-First Street, New York 36, N. Y.) is aimed primarily at practicing engineers desiring review before taking the closed-book or fundamentals portion of state professional engineering examinations. It covers all phases of engineering in concise detail, with particular emphasis on the eight different fields of engineering that ordinarily appear on the examinations: mathematics, mechanics, fluid mechanics, themodynamics, mechanics of materials, electricity and electronics, chemistry, and economics and investment theory. Principles of physics, as they apply to the various subjects discussed, are interspersed throughout since many states include miscellaneous problems concerning physics. Chapter 2, "Mechanics," and Chapter 3, "Fluid Mechanics," for example, cover many of the elementary physical principles as they apply specifically to fluids, while Chapter 4, "Thermodynamics," and Chapter 6, "Electricity and Electronics," include discussions of the fundamental physical relationships of these subjects.

Although emphasis throughout is on technical material and on the coverage of the fundamentals portions of all state examinations, the author, Lloyd M. Polentz, also stresses methods. The book follows a 3-step sequence. First, engineering principles are defined and discussed. Next, they are illustrated through the solution of sample problems. Finally, a group of sample problems is provided at the end of each chapter, with the answers appearing at the end of the book.

Lloyd M. Polentz, P. E., consulting engineer, is an instructor in engineering fundamentals for the University of California Extension Division. He has also done extensive work for Robertshaw-Fulton Company, the University of California Radiation Laboratory, and other organizations. 360 pages. Cost, $9.50.

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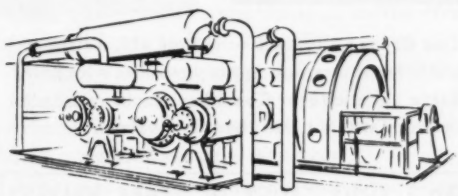

The hydrogen is produced from crude oil by partial oxidation, and is then compressed, purified and liquefied.

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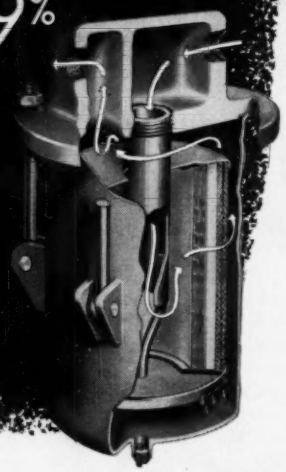

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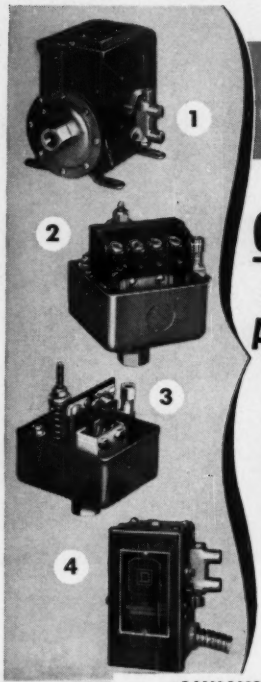

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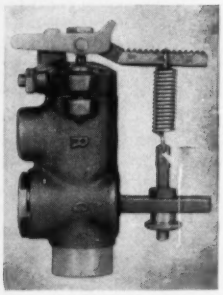

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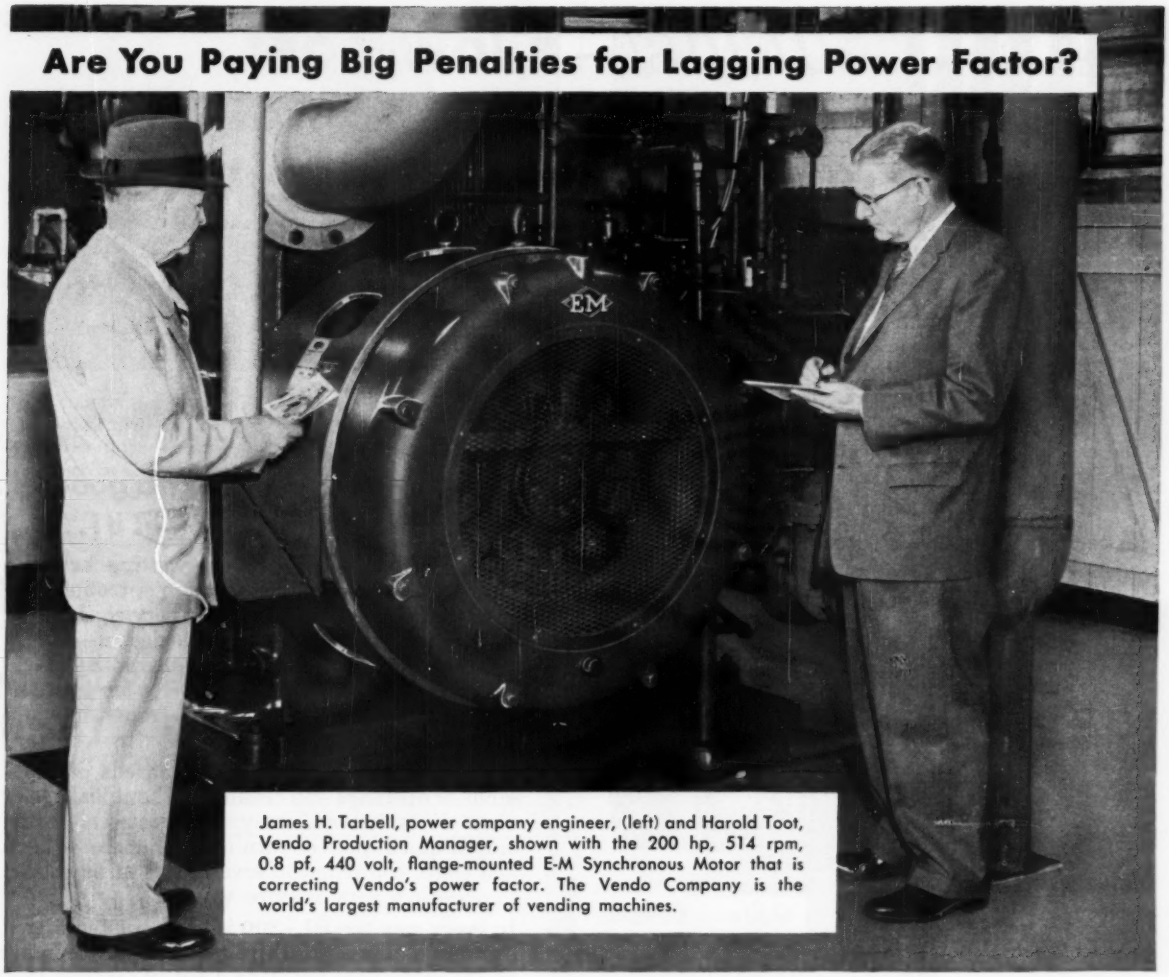

James H. Tarbell, power company engineer, (left) and Harold Toot, Vendo Production Manager, shown with the 200 hp, 514 rpm, 0.8 pf, 440 volt, flange-mounted E-M Synchronous Motor that is correcting Vendo's power factor. The Vendo Company is the world's largest manufacturer of vending machines.

Vendo Company Corrects Power Factor...SAVES $450 A YEAR! with an E-M Synchronous Motor

The Vendo Company, Kansas City, Missouri learned its plant was operating at a lagging power factor condition when expanded production facilities required more compressed air. A study by Vendo's engineers and Kansas City Power & Light Company showed an 0.8 leading power factor synchronous motor compressor drive would save them money. Here's how:

Vendo's power contract provides a penalty of 20 cents a month for every reactive kva exceeding one-half the maximum kilowatt demand. *This was costing Vendo $33.00 per month, or $396.00 a year!*

A 20 cents a month bonus is granted for every kilovar the reactive demand falls short of one-half the maximum kilowatt consumption. A 200 hp E-M Synchronous Motor with 0.8 pf would provide enough reactive kva for Vendo to operate at a *leading* power factor and earn a monthly credit of $4.60. Vendo's power bill would then be reduced by $37.60 a month, or $451.20 a year!

Vendo installed the recommended E-M Synchronous Motor . . . and has been enjoying a reduced power bill ever since. You, too, can make a big saving in your plant power bill by correcting your power factor with highly efficient E-M Synchronous Motors.

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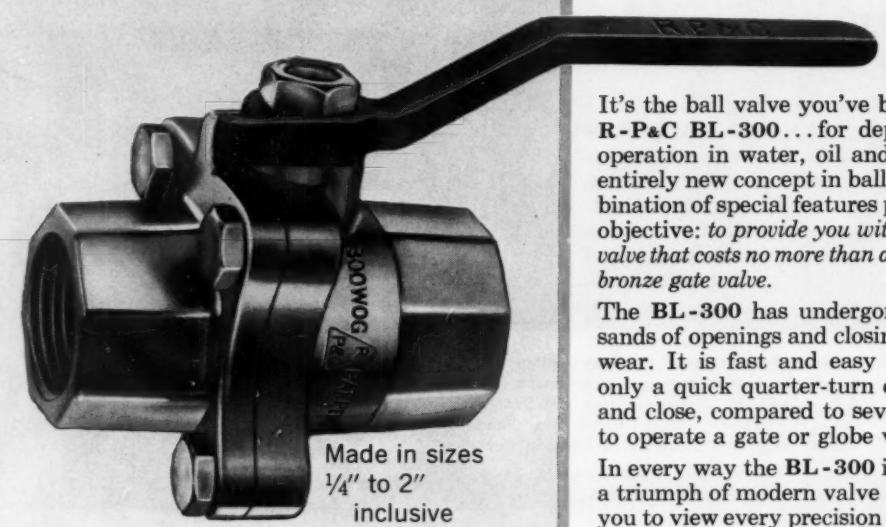

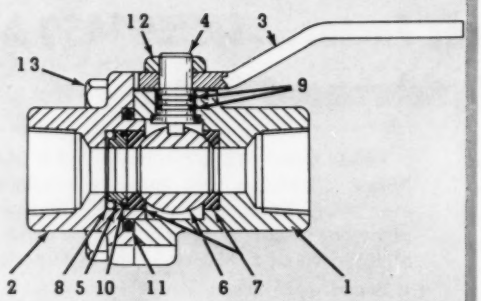

BODY (1) and **CAP** (2)—Forged Naval Bronze; **HANDLE** (3)—Malleable Iron; **STEM** (4), **DISC** (5) and **BALL** (6)—Naval Bronze; **SEAT** (7)—Buna "N" or Teflon; **SPRING** (8)—Phosphor Bronze; **O-RINGS** (9, 10, 11)—Buna "N" or Viton; **NUT** (12)—Cadmium Plated; **SCREW** (13)—Carbon Steel

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It's the ball valve you've been waiting for... the **R-P&C BL-300**... for dependable, trouble-free operation in water, oil and gas service. It is an entirely new concept in ball valve design—a combination of special features perfected with but one objective: *to provide you with a precision-built ball valve that costs no more than a high quality, standard bronze gate valve.*

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In every way the **BL-300** is truly outstanding... a triumph of modern valve technology. We invite you to view every precision detail of this new low-cost ball valve in a personal demonstration with your R-P&C distributor. Or, write us at Reading, Pa., and we will gladly send you descriptive **Folder DH-38A** containing complete product information and specifications.

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- The **BL-300** has "auto-mating" seats to assure positive sealing in either flow direction, making it ideal for vacuum service.
- Perfectly machined ball combines with auto-mating seats for smooth, positive valve operation.
- Wiping action of ball across seats prevents accumulation of foreign matter, eliminates maintenance.
- Choice of two seats—Buna "N" or Teflon—for your service requirements.
- Two "O" ring stem seals assure a leak-proof stuffing box for the entire service life of the valve.
- With Buna "N" seats, the **BL-300** is rated for 300 psi—water, oil, gas—at 250°F maximum; with Teflon seats, 300 psi—wog—at 450°F maximum.

*Teflon is a registered trademark of the E. I. DuPont de Nemours Co.

R-P&C VALVES

R-P&C Valve Division • American Chain & Cable Company, Inc.

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ACCO

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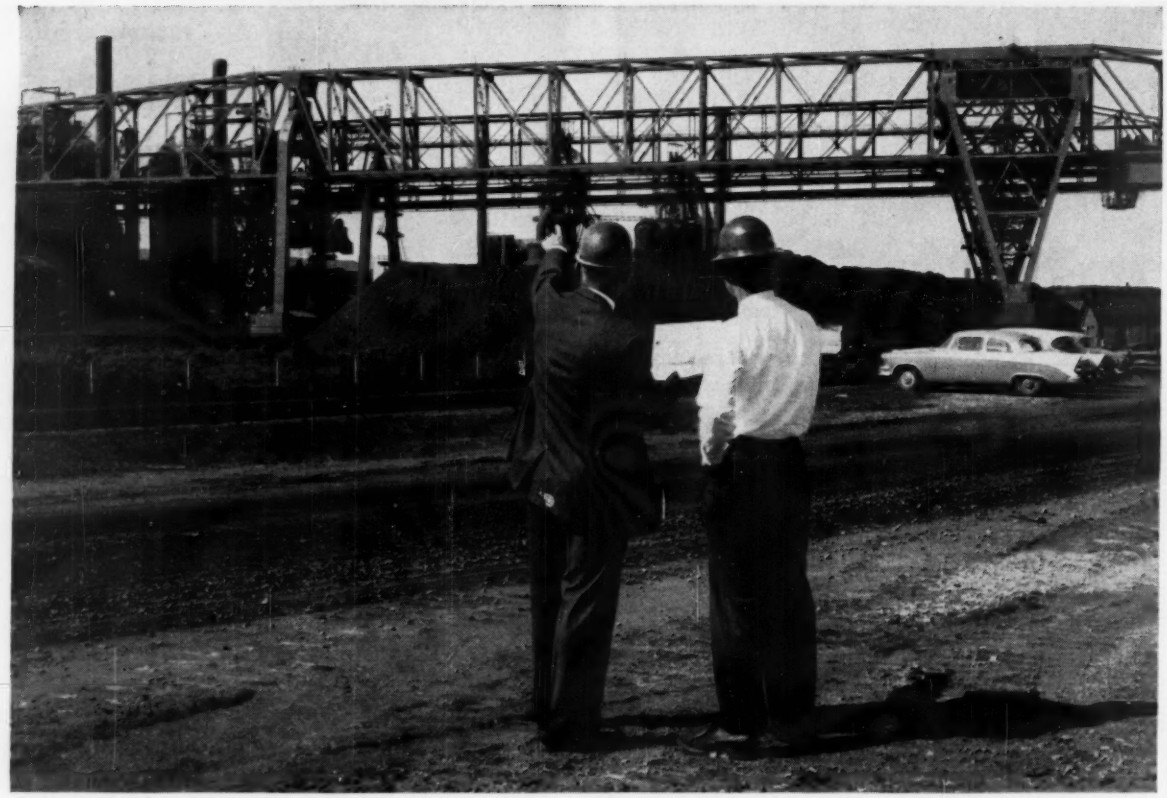
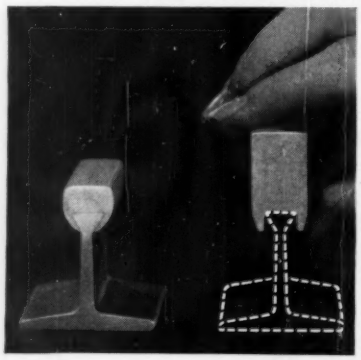


Another way copper from Anaconda is helping cut the cost of getting electricity to the job

It's not a simple job to get electricity to big heavy-current motors that travel on moving cranes, ore bridges, monorails. In heavy-duty use where high amperage is needed, steel rails weighing 60 to 80 pounds per yard have carried the power. Then came extruded aluminum rails that were lighter and easier to install. But aluminum would wear and pit from friction of the current collectors unless protected by grease. Furthermore, unprotected aluminum rails if not used for a while acquire an oxide coating that is an electrical insulator.

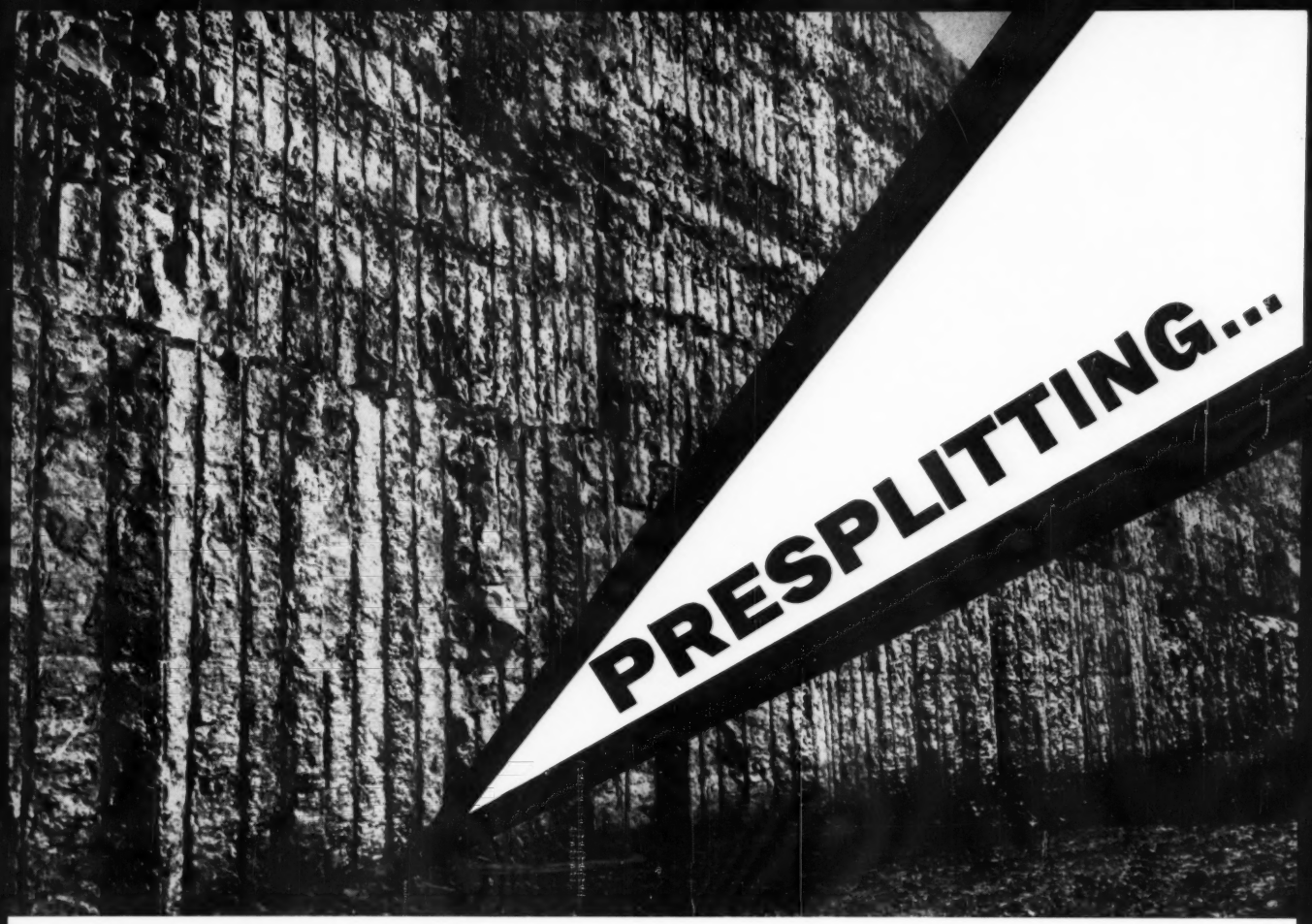


An ingenious solution that cuts costs all around involves a happy wedding of steel and copper. The compact little copper-headed steel conductor rails manufactured by the Ringsdorff Carbon Corp., shown at left, have current-carrying heads of extruded Anaconda copper. Because copper conducts electricity better than any other commercial metal, the rails take up very little space. The steel portion provides the strength needed and makes installation easy. The best part of it is that the graphite used in the sliding current collectors has an affinity for copper, lubricating and protecting as it goes. This cuts the cost of maintaining the system. Wear on the copper is negligible and carbon shoes need replacement only every one to three years.

This use of copper, industrial winner of the 1961 Annual Copper and Brass Achievement Awards, illustrates another way copper from Anaconda is helping industry do things better and at lower cost. Whether the problem is to get electric power from a substation to an ore-bridge motor — or from a power plant to the heart of a city — Anaconda, through its subsidiaries, Anaconda American Brass Co., and Anaconda Wire and Cable Co., is constantly working with industry to find new solutions . . . to help provide more value for less money. 61190

ANACONDA®

Subsidiaries of Anaconda Manufacture: Copper and aluminum electrical wires, cables and accessories; Aluminum ingot, sheet, plate, plain and laminated foil, rigid foil containers, restaurant and household foil wrap; Copper, Brass, and Bronze sheet, plate, strip, tube, pipe, rod, wire, forgings, extrusions; fabricated metal products; flexible metal hose and tubing.



AN IMPORTANT NEW BLASTING TECHNIQUE PIONEERED BY HERCULES

PRESPLITTING is a forward step in the advancement of a more efficient blasting technique. This new method of controlled blasting, pioneered by Hercules Powder Company, produces "line-drilled" results without the excessively high costs of actual line drilling.

PRESPLITTING has the following advantages over normal methods of blasting:

1. Rock overbreak behind the PRESPLIT blast holes reduced to an absolute minimum—*less extra unpaid-for excavation and less concrete required because excess overbreak is eliminated.*

2. Fewer blast holes required than for line drilling—*extra dollar savings in drilling costs.*

3. Reduction in ground vibrations from primary blasting—*fewer complaints from nearby householders and industries.*

4. Sheer, clean rock wall obtained—*greatly reduced scaling time.*

5. Back shattering reduced—*much safer wall to work under; walls require less maintenance.*

6. Entire cut may be PRESPLIT with one blast—*saves resetting up time.*

Detailed technical information about PRESPLITTING is available in bulletin form. Ask your Hercules representative for a copy and learn how PRESPLITTING will reduce costs on your job.

Explosives Department

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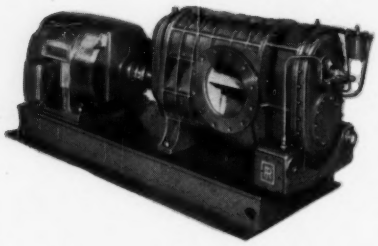
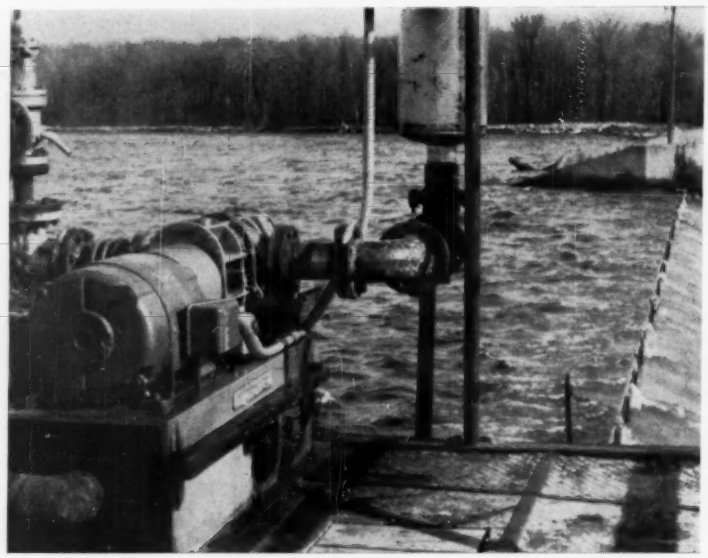
Axi-compressor

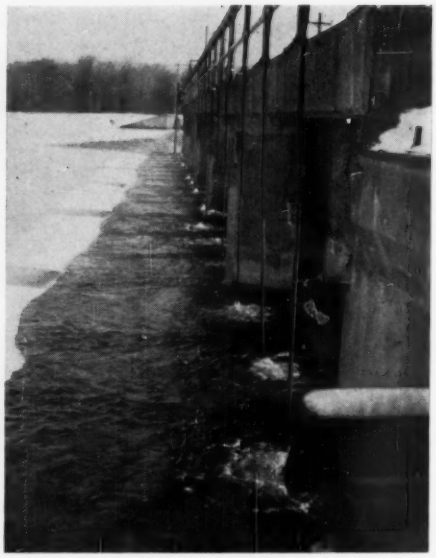
makes effective



DAM DE-ICER



Ingersoll-Rand Axi-compressor installed on power dam of The Mead Corporation to prevent icing by air-agitation of the water.



Upstream side of dam, showing air lines from header extending down into agitated ice-free water.

The long, cold winters of Michigan's Upper Peninsula are hard on dams. Heavy and prolonged icing causes rapid erosion of even the strongest reinforced concrete. After making extensive repairs to its power dam at Boney Falls, The Mead Corporation, a leading paper manufacturer, installed a simple yet highly effective air-agitation system to protect against future ice damage.

The anti-icing system uses low-pressure air to agitate the water along the upstream side of the dam and bring the warmer sub-surface water up to the top. For this purpose, an Ingersoll-Rand positive displacement Axi-compressor was installed midway across the dam, delivering 295 cfm at 10 psig to a 4″ header line extending the length of the structure. Every few feet along the header, hoses extend downward into the water to 7 feet below mean level. Each hose terminates in a metal pipe with a 5/64-inch orifice which emits air for bubbling. As shown in the photo at right above, the uprising air and water keep the river ice a safe distance back from the dam.

The Axi-compressor is an ideal unit for this type of service. Being small and free from vibration, it can be installed on a simple, low-cost foundation. And maintenance costs are low because the two meshing helical rotors do not touch each other or the casing and hence have no mechanical wear.

Ingersoll-Rand Type L Axi-compressors are available in capacities from 100 to 12,000 cfm, for pressures to 15 psig and vacuums to 22″ Hg. Ask your Ingersoll-Rand engineer for complete information, or send for a copy of Bulletin No. 11,003.

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